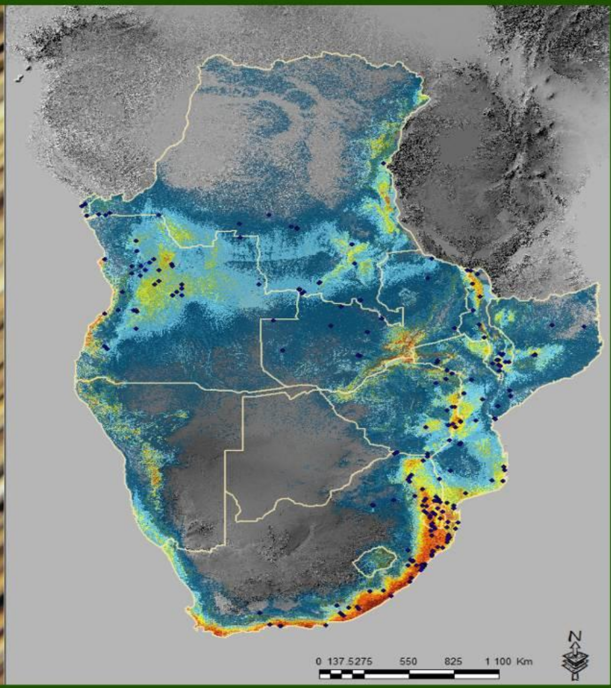
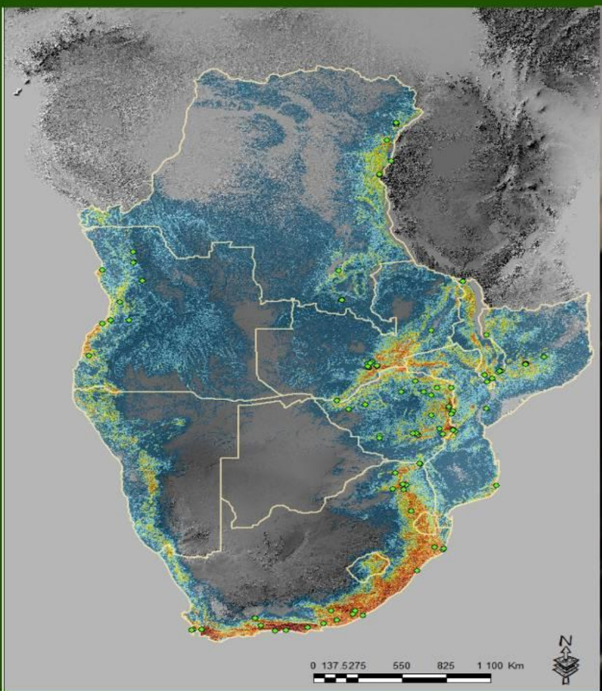


DESKTOP BAT ASSESSMENT

FOR THE

ESKOM GAMMA-KAPPA POWERLINE PROJECTS IN THE WESTERN & NORTHERN CAPE PROVINCES



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Date: August 2017

All pictures taken on site

DESKTOP BAT ASSESSMENT UPDATE – Gamma to Kappa Power Line

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Ref No: 2367
Date: August 2017

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LIST OF ACRONYMS

ACRONYM	DESCRIPTION
CFR	Cape Floristic Region
CI	Conservation Importance
CITIES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
ECA	Environment Conservation Act
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPR	Environmental Management Programme Reports
EN	Endangered – a Red Data classification used by the IUCN for describing species in danger of facing extinction
GDARD	Gauteng Department of Agriculture and Rural Development
GK	Gamma to Kappa
I&AP	Interested and Affected Party
ICMM	International Council on Mining and Metals
IUCN	International Union for the Conservation of Nature, based in Gland, Switzerland
LC	Least Concern - – a Red Data classification used by the IUCN for describing species not in danger of facing extinction
LoO	Likelihood of Occurrence
NBSAP	National Biodiversity and Action Plan
NEPAD	The New Partnership for Africa's Development
NFEPA	National Freshwater Ecosystem Priority Areas
NHS	Nzumbululo Heritage Solutions
NPA	National Priority Area
NSBA	National Spatial Biodiversity Assessment
NSS	Natural Scientific Services CC
NT	Near Threatened – a Red Data classification used by the IUCN for describing species not yet in danger of facing extinction, but close to such a state
PrSciNat	Registration as a Professional Natural Scientist
QDGS	Quarter Degree Grid Square – the basic unit used by the Surveyor General for creation of 1:50 000 topographical maps
SABAAP	South African Bat Assessment Advisory Panel
SANBI	South African National Biodiversity Institute
SASS5	South African Scoring System Version 5
SMP	Strategic Management Plan
UNFCCC	United Nations Framework Convention on Climate Change
VU	Vulnerable – a Red Data classification used by the IUCN for describing species in danger of facing extinction

1. Introduction

This report represents an update to the initial NSS study that was commissioned by Nzumbululo Heritage Solutions (NHS) in 2013 following comments raised by an I&AP. The report involves a desktop level bat assessment for Eskom's Gamma to Kappa (370 km) power line project in the Western and Northern Cape provinces in which Eskom intend to install a 765kV power line along one of three possible route alternatives (GK alt 1, 2 or 3). This study was commissioned by Nzumbululo Heritage Solutions (NHS). Changes herein include updates to the legislative and biophysical setting as well as the species distribution models themselves. Overall findings are largely in agreement with the initial study in that the habitat within the study area is largely unsuitable for fruit bats and that GK alt 3 was the least preferable. Although there is little difference between GK alt 1 and 2 in terms of climatic suitability GK alt 1 is less preferable as its southerly trajectory most closely approaches the modelled coastal distribution of the two fruit bat species. Since the initial report, Eskom has opted for GK alt 2. In NSS' opinion this is the preferred option not only from a climatic suitability and roost availability perspective but also because it largely parallels existing powerline infrastructure. The other alternatives have been retained in this report for comparative purposes.

Bats play an important role in the ecosystem, benefiting both biodiversity and humans alike through the pollination, seed dispersal, and pest control services they provide. Fruit and nectar-feeding bats for instance aid in seed dispersal and pollination, upon which many of the world's economically important crop varieties are dependant. Insectivorous bats help to control agricultural pests and disease vectors such as malaria carrying mosquitoes (Kalka *et al*. 2008; Gonsalves *et al.* 2013). The important ecological roles that bats fulfil make them a keystone group that are excellent indicators of environmental disturbance (Fenton & Ratcliffe 2010). Additionally, bats represent a significant portion of vertebrate biodiversity (Simmons 2005), and are among the most overlooked, yet economically important, non-domesticated animals. The conservation of bats is therefore, in the best interest of national and international economies (Boyles *et al*. 2011). Unfortunately, many bat species (particularly cave-dwelling and migratory species) are susceptible to severe population crashes, as they often congregate in large numbers in specific locations are relatively long-lived, have low fecundity and slow growth rates (Hester and Grenier 2005; O'Shea *et al*. 2003). Consequently, disturbance of only a few populations can have a devastating impact on a species.

Power lines represent one such possible disturbance, potentially negatively impacting bats both directly and indirectly through collision and electrocution, as well as habitat loss and sensory disturbance. In recognition of the environmental, health and safety aspects associated with electrical transmission lines, the International Finance Corporation (IFC) and World Bank published guidelines in 2007. In these guidelines, they highlight the risks to birds and bats associated with potential collision and electrocution, as follows:

Birds and bats may be electrocuted by power lines in one of three ways: i) Simultaneously touching an energized wire and a neutral wire; ii) Simultaneously, touching two live wires; and iii)

Simultaneously touching an energized wire and any other piece of equipment on a pole or tower that is bonded to the earth through a ground wire. Bird collisions with power lines have been shown to occur in large numbers if located within daily flyways or migration corridors, or if groups are travelling at night or during low light conditions (e.g. dense fog). In addition, bird and bat collisions with power lines may result in power outages and fires. The guidelines stipulate a set of mitigation measures specific to bats and even more specifically to powerlines. These are discussed in Section 7 of this desktop assessment.

The objectives of this desktop assessment were to provide an update (where necessary) on the original objectives which included:

- A concise list of applicable international, regional, national and provincial biodiversity legislation, policies, guidelines and spatial plans relevant to bats.
- Basic description of the background environment - local climate, terrain, hydrology, vegetation, land-use and relevant biodiversity conservation initiatives.
- A list of potentially occurring bats.
- A brief discussion of potentially occurring Conservation Important (CI) bats, and current potential threats to local and regional bats.
- A brief discussion of anticipated impacts of the proposed powerlines on local and regional bat populations.

2. Receiving Environment

2.1. Location and Land-use

The three Gamma to Kappa powerline routes (GK alt 1,2,3) all extend from Gamma in the north (situated between Murraysburg and Victoria West) for 357 km in a south-westerly direction to Kappa (near Breede River DC). Gamma to Kappa (GK) alternatives 2 and 3 traverse a small section of the Northern Cape while GK alt 1 takes a more southerly trajectory remaining within the Western Cape Province (**Figure 2-2**).

A map of the 2014 Western Cape Land-cover data is provided in **Figure 2-3**. This high resolution (30 m) spatial dataset was derived from LandSat 8 imagery and exhibits several province specific additions to the initial version created by GeoTerraImage. The dataset includes 122 classes.

2.2. Vegetation and Biomes

From Gamma in the north to Kappa in the south, the three power line route alternatives traverse three vegetation biomes. The most northerly is the Nama Karoo biome, through which most of the power line routes extend before crossing into the succulent Karoo biome in the south with isolated patches of the Fynbos biome intercepting power line routes GK alt 2 and GK alt 3 (**Figure 2-6**).

Compared to the succulent Karoo and Fynbos biomes, the Nama Karoo biome supports a relatively low plant species diversity. Rainfall is simply too unpredictable to support the diversity of succulent plants characteristic of the succulent Karoo biome, while in summer the climate is too dry to support swards of perennial grasses and the soils to shallow to support large trees. The plants which do occur (members of the families Asteraceae, Fabaceae and Pocaceae) are those typically associated with arid environments. In contrast, the succulent Karoo Biome is particularly species rich supporting some 6356 vascular plant species with as many as 26 % (mostly succulents or geophytes) being endemic to the biome. As the name suggests, the biome is dominated by a wide diversity succulents (particularly of the family Aizoaceae) supporting approximately 16 % of the worlds 10 000 succulent species (Mucina & Rutherford, 2006). Most speciose of all three is the Fynbos biome, characterised by plants of the family Ericaceae. The biome makes up the majority of the Cape Floristic Region (CFR) the most species rich floral kingdom in the world per unit area. The CFR is home to an extraordinarily high diversity of more than 9 000 vascular plant species, of which most (69 %) are endemic (Odendaal *et al.* 2008).

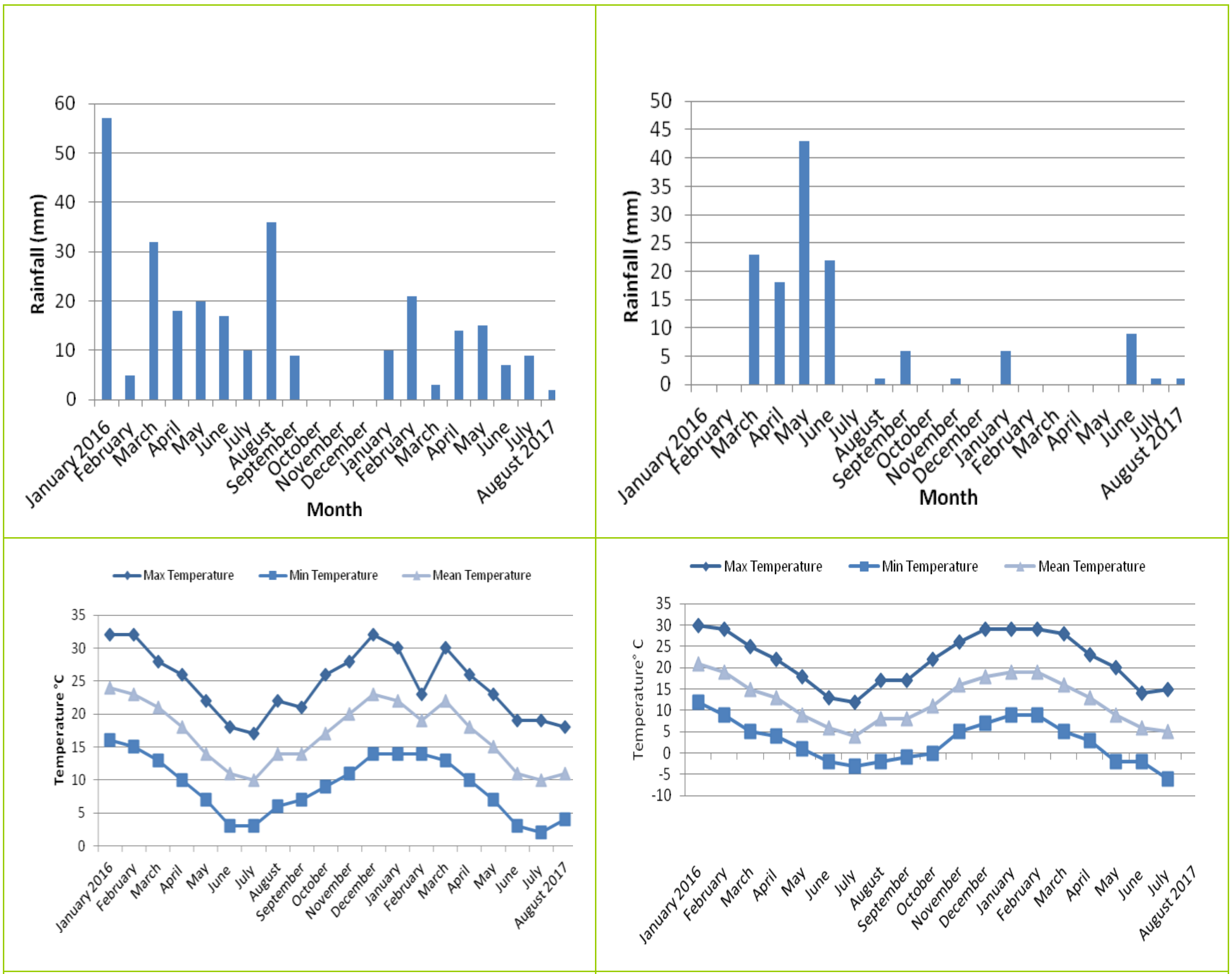
2.3. Geology and soils

The Gamma to Kappa power line route alternatives traverse three main geological subgroups of the Palaeozoic Karoo Supergroup. From Gamma to Kappa these include the Beaufort, Ecca and Dwyka groups. The Beaufort group is divided into two subgroups of which the Adelaide Subgroup is applicable here, covering the majority of the power line route alternatives. The Adelaide Subgroup is comprised mainly of alternating grey mudstones and fine lithofeldspathic sandtones but also includes shales, limestones and coal deposits. As the power line alternatives (particularly GK alt 1) extend further south they cross the Ecca Group, comprised mainly of shales and deltaic sandstone, with deposits of grit and coal that once formed the bottom of an inland lake. These sediments underwent metamorphosis giving rise to the rocks of the Beaufort Group and which yield excellent examples of vertebrate fossils. Finally the power line routes terminate in the stratified diamictite facies of the Dwyka Group sandwiched between the Ecca Group and Cape Supergroup. The Dwyka Group is derived from glacial materials deposited some 300 million years ago following the melting of Gondwanal ice sheets (Johnson *et al*. 2006; GEOSA, 2013).

2.4. Climate

Given the scale of the study area, regional climate is described here at a biome level. The climate of the Nama Karoo biome (which predominates over the northern reaches of the study area) is essentially continental, hot and arid. Temperatures range from -5 °C in winter to 43 °C in summer. Frosts are frequent in winter while whirlwinds are common in summer. Rainfall is low and unreliable with droughts occurring unpredictably. Mean annual precipitation varies from 70 mm in the most arid regions to 500 mm in the most mesic regions of the biome (Mucina & Rutherford, 2006). Precipitation and temperature data for the town of Beaufort West (within the Nama Karoo biome) from 2016 to present is presented in **Figure 2-1** (WeatherSA, 2017; Accuweather, 2017).

Towards the southern end of the study area, the succulent Karoo biome becomes more prevalent. This biome is classified as a semi-desert region. Unlike the Nama Karoo biome, the climate within the succulent Karoo biome has a strong coastal influence and is more effectively buffered from extreme variations in temperature and precipitation. The Mean annual temperature for the biome is 16.8°C and the MAP fluctuates only mildly (100-200 mm reflecting its milder more temperate climate than the afore-mentioned biome Mucina & Rutherford, 2006). Precipitation and temperature data for the town of Laingsburg (within the Nama Karoo biome) from 2016 to present is presented in **Figure 2-1** (WeatherSA, 2017; Accuweather, 2017).



Beaufort West | Laingsburg

Figure 2-1 Annual precipitation and temperature data from 2016 to present for the towns Beaufort West (north-east) and Laingsburg (south-west) located within the study area.

2.5. Conservation important areas

2.5.1 National Priority Areas

According to the South African National Biodiversity Institute (SANBI) spatial data, a portion of the power line route alternative GK alt1 falls within the Cape Floristic Region priority area (**Figure 2-7**), while the remaining sections of the power line routes do not fall within a recognised National Priority Area (NPA). The NPA assessment was based on integrating data on species, habitats and ecological processes to identify areas of greatest biodiversity significance. This resulted in the identification of nine spatial priority areas for terrestrial biodiversity. These priority areas represent areas with high concentrations of biodiversity features and/or areas where there are few options for meeting biodiversity targets (Rouget *et al.*, 2004).

2.5.2 National Freshwater Ecosystem Priority Areas

In addition to the NPAs, SANBI, in collaboration with DWA, DEA, WRC, SANParks, WWF, CSIR and the NRF have further prioritized Freshwater systems in the country with an aim to incorporate conservation into Catchment Management Strategies (Driver *et al*, 2011). The objectives set for the project included:

1. The identification of National Freshwater Ecosystem Priority Areas (hereafter referred to as 'NFEPAs') to meet national biodiversity goals for freshwater ecosystems; and
2. Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

FEPAs should be regarded as ecologically important and as generally sensitive to changes in water quality and quantity, owing to their role in protecting freshwater ecosystems and supporting sustainable use of water resources (Driver *et al*, 2011). Further to this, Driver *et al* (2011) recommend that FEPAs that are in a good condition should remain so. FEPAs that are not in a good condition should be rehabilitated to their best attainable ecological condition. Such that land-use practices or activities that will lead to their deterioration or that will make rehabilitation of a wetland FEPA difficult or impossible are not acceptable.

Wetlands and rivers are very important to bats as foraging and drinking areas and movement corridors (Sirami et al., 2013; Serra-Cobo et al., 2000; Akasaka et al., 2009, Hagen and Sabo, 2012; Lloyd et al., 2006).

The following NFEPA Project categories (**Figure 2-8**) are bisected by the 3 power line route alternatives:

- GK alt 1: 6x FEPAs, 2x phase 2 FEPAs, 2x unclassified systems and 1 x fish support area
- GK alt 2: 7x FEPAs, 2x phase 2 FEPAs and 2x unclassified systems.
- GK alt 3: 6x FEPAs, 2x phase 2 FEPAs and 3 x unclassified systems

2.5.3 Threatened Ecosystems

A list of Threatened Ecosystems within the nine National Priority Areas was gazetted on 9 December 2011 in NEMBA (Act 10 of 2004). These Threatened Ecosystems occupy 9.5% of South Africa and were selected according to six criteria which included; (1) irreversible habitat loss, (2) ecosystem degradation, (3) rate of habitat loss, (4) limited habitat extent and imminent threat, (5) threatened plant species associations and (6) threatened animal species associations. According to the recently approved list, the majority of the study area is not zoned as a Threatened Ecosystem (**Figure 2-9**). The Western Cape has recently updated the threat status assigned to Ecosystems within the province. The study area is zoned as Least Threatened (**Figure 2-5**).

2.5.4 Protected Areas

Using datasets provided by conservation agencies and governments, the Succulent Karoo Ecosystem Plan (SKEP) has compiled a detailed spatial database of the geographic extent of both current and proposed protected areas (PAs) in South Africa and Namibia. Information provided by the database is important in assessing the contribution of existing protected areas to meeting conservation targets and to identify gaps in the protected area network.

With as little as 3.5 % of the Succulent Karoo biome under formal protection, the biome is currently inadequately protected to ensure the conservation of its biodiversity and the ecosystem services they provide. The Gamma to Kappa power line route alternatives traverse two SKEP Protected Areas and several NPAES focus areas for reserve network expansion. The most significant of the SKEP PAs traversed by the power line route alternatives is the Karoo National Park which would be traversed in its south west region by GK alt 3 (**Figure 2-10**).

2.5.5 Geographic Priority Areas

In recognition of the high levels of biodiversity supported within the Succulent Karoo biome and the correspondingly high levels of transformation faced by the Biome Conservation International's Southern Africa Hotspots Programme launched the planning phase of the Succulent Karoo Ecosystem Plan (SKEP) in January 2002. The main aim of the Succulent Karoo Ecosystem Plan (SKEP) is to provide an overarching framework to guide conservation efforts in the Succulent Karoo. In addressing this aim, SKEP's team of scientists assessed the area that would be needed to effectively conserve the biomes diversity and the ecological processes that support it. Based on this information conservation targets for biodiversity features such as vegetation types, river ecosystems, sand movement corridors, presence of Red Data and endemic species, were set. In total nine geographic priority areas (GPA) were identified throughout the SKEP process (Driver *et al*. 2003).

Although none of the power line alternatives traverse any of these GPAs GK alt3 borders the Hantam-Roggeveld GPA for a short distance (**Figure 2-11**). The Hantam-Roggeveld GPA is positioned within an ecotone between the Succelent Karoo, Nama Karoo and Fynbos Biomes and such is particularly species rich supporting some 1,767 plant species of which 357 are Succulent Karoo endemics and 173 are Red List species. The GPA encompasses an area of 932,140-hectare that covers both the Bokkeveld and Roggeveld escarpments an area characterised by rugged slopes and cool highlands which support a unique assemblage of species. The GPA has been highlighted as an area with very low levels of transformation that may provide excellent opportunities for the conservation of cold adapted montane plant species as well as upland and lowland migration routes of fauna (CEPF, 2013).

2.5.6 Western Cape Biodiversity Spatial Plan (WCBSP) 2017.

Datasets for Beaufort West, Laingsburg and Price Albert were sourced from the SANBI BGIS online repository. As stated on the BGIS (2017): "*The WCBSP is the product of a systematic biodiversity planning assessment that delineates, on a map (via a Geographic Information System (GIS)), Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) which require safeguarding to ensure the continued existence and functioning of species and ecosystems, including the delivery of ecosystem services, across terrestrial and freshwater realms. These spatial priorities are used to inform sustainable development in the Western Cape Province. This product replaces all previous systematic biodiversity planning products and sector plans with updated layers and features*".

The various powerline routes bisect numerous different conservation classes (Critical Biodiversity Areas 1 and 2, Ecological Support Area 1 and 2, Other Natural Areas, Protected Areas). A thorough treatment of the various classes intersected by each powerline route lies beyond the scope of this project but it suffices to say that Eskom take cognisance of the conservation importance of the various biodiversity areas they will be crossing and responds accordingly by consulting the WCBSP (2017) supporting documentation.

2.6. Applicable legislation

2.6.1 International Legislation & Policy

- Convention on Biological Diversity (Rio de Janeiro, 1992);
- The Bonn Convention (on conservation of migratory species of wild animals);
- The World Heritage Convention, 1972;
- The Ramsar Convention (on wetlands of international importance especially as waterfowl habitat). This is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance but also to plan for the "wise use", or sustainable use, of all of the wetlands in their territories. For this report, the floodplain habitat is considered part of a wetland system.
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- The IUCN (World Conservation Union);
- The United Nations : Agenda 21, Rio +5 and the Johannesburg -World Summit on Sustainable Development, 2002;
- The UN Framework Convention on Climate Change (UNFCCC), 1994
- The Kyoto Protocol, 1997
- The United Nations Climate Change Conference or the Copenhagen Summit, and the Copenhagen Accord, 2009.
- Copenhagen Accord on Climate Change.
- 17th Conference of the Parties on Climate Change.
- Paris Agreement on global warming.

2.6.2 Regional Level

- The Action Plan of the Environmental Initiative of NEPAD (the New Partnership for Africa's Development), 2003. This initiative encourages sustainable development and associated conservation and wise use of biodiversity.
- African Convention on the Conservation of Nature and Natural Resources, 1969

2.6.3 National Level

- South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction Fourth Edition: (Sowler *et al*.2016).
- Constitution of the Republic of South Africa (Act 108 of 1996);
- National Environmental Management Act, 1998 (Act 107 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004);
- National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
- National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003);

- National Water Act, 1998 (Act 36 of 1998);
- Environment Conservation Act, 1989 (ECA), (Act no. 73 of 1989);
- Conservation of Agricultural Resources Act (Act 43 of 1983).
- National Veld and Forest Fire Act (Act 101 of 1998).
- National list of Ecosystems Threatened and in need of Protection under Section 52(1) (a) of NEM:BA (Government Gazette [GG] 34809 - Government Notice [GN] 1002, 9 December 2011).
- Alien and Invasive Species Regulations (GG 37885 - GN 598, 1 August 2014).
- Threatened or Protected Species (ToPS) Regulations (GG 38600 - GN 255, 31 March 2015).

2.6.4 National Policy and Guidelines

- South Africa's National Biodiversity Strategy and Action Plan (NBSAP);
- National Spatial Biodiversity Assessment (NSBA) – part of the NBSAP process;
- National Freshwater Ecosystem Priority Areas (NFEPA's)
- International Council on Mining and Metals (ICMM) - Good Practice Guidance for Mining and Biodiversity

2.6.5 Provincial Legislation

In addition to national legislation, some of South Africa's nine provinces have their own provincial biodiversity legislation, as nature conservation is a concurrent function of national and provincial government in terms of the Constitution (Act 108 of 1996). General provincial biodiversity guidelines are provided by Cape Nature (www.capenature.co.za) and specify among other things, that permits are required for work that involves hunting (killing), transport or captive housing of wild animals. Relevant provincial legislation includes:

- Western Cape Nature Conservation Laws Amendment Act No. 3 of 2000
- Western Cape Nature and Environmental Conservation Ordinance Amendment Act, No 8 of 1999
- Nature Conservation Ordinance No 19 of 1974
- Guideline for involving biodiversity specialists in EIA processes (2005): Provincial government of the Western Cape – Department of Environmental Affairs and Development Planning
- Systematic Biodiversity Conservation Planning in the Western Cape: SANBI
- Western Cape Provincial Spatial Development Framework: Statutory Report (2013 – Draft for public comment). Provincial Government of the Western Cape – Department of Environmental Affairs and Development Planning
- Western Cape State of Biodiversity (2012): Cape Nature Scientific Services
- Western Cape Biodiversity Framework (2010)

2.6.6 Buffer Zones

At the time of the initial Gamma to Kappa Bat Assessment report the official bats-specific buffer guidelines were lacking and were based on the outcomes of a specialist "Bats and Wind Energy" workshop convened in Johannesburg by NSS in May 2013. During the meeting some preliminary buffers were put forward and it was suggested that formal buffers should be agreed upon by bat specialist consultants, academics, the Endangered Wildlife Trust, provincial conservation authorities and citizen scientists with extensive bat expertise, who were elected during the workshop to represent a South African Bat Assessment Advisory Panel (SABAAP).

Much progress has been made in the interim, with the recent publication of the South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: 4th Edition (Stoffberg *et al*. 2016). Although centred on wind energy the guideline document does include specific recommendations for powerlines. To this end the document states: "*No powerline infrastructure should be constructed within 2km of any large known confirmed roosts and 500m from smaller confirmed roosts. However, power lines can cross bat important foraging areas area, as long as all the other water use license mitigation measures are in place in the case of wetlands and rivers*".

Taking a conservative approach each power line route alternative was assigned a buffer of 2.5 km for the calculation of habitat suitability and for the calculation of potential roost habitat as applicable to *Rousettus aegyptiacus* and other cave/crevice dwelling species,.

Although well intended for conservation purposes, the issue of placing a standardised buffer on conservation important habitats, plant or animal localities has a number of limitations:

- Buffer distances are often based largely on educated guesses, considering the scant amount of scientific research.
- If a buffer is placed on a particular habitat, the success of that buffer working is dependent on the requirement of all species and ecosystems utilizing that habitat. Different species and ecosystems usually have different needs.
- If enough pressure exists for a particular development, buffers will be relaxed to accommodate that development.
- For non-linear conservation important areas, a radial buffer is presumed; however, often habitats will be far more suitable on one side of the area than the other. Therefore, a radial buffer may not be appropriate – it may be more appropriate to select specific patches of suitable habitat around the sensitive ecological entity that will ensure its survival.
- Not all South African provinces have developed policies or guidelines on buffers.
- Guidelines change of space and time so it is worth taking cognisance of others such as.:
    - The Gauteng Department of Agriculture and Rural Development (GDARD 2009) recommends a 500m buffer on natural caves systems, a 200m buffer on Class 1 ridge systems, a 200m buffer on conservation important vegetation, and a 50m buffer on riparian edges. All of these represent important bat habitats.
    - Guidelines such as the Eurobats Guidance and the Natural England Technical Note (Mitchell-Jones & Carlin 2009) give some indication of buffer zones which may be applicable, in the absence of limits in South Africa:
        - The Eurobats Guidance (Rodrigues *et al*. 2008) proposes a minimum distance of 200m to forest edges where forest clearing and tree felling is necessary to establish a wind farm.
        - The Natural England Interim Guidance suggests a 50m buffer from wind turbine blade tip to the nearest feature (tree top or house).

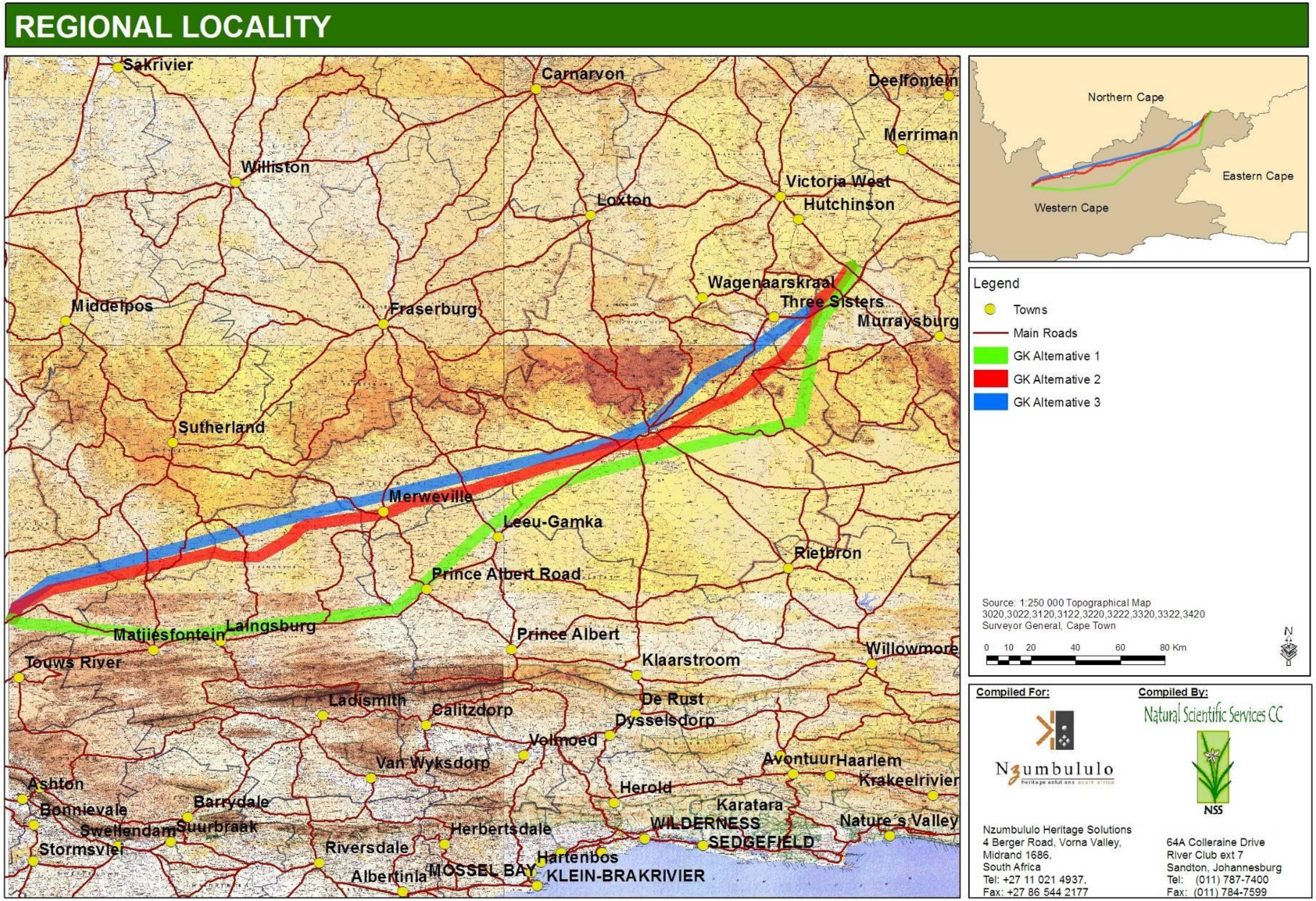


Figure 2-2 Locality map showing the routes taken by each of the three ESKOM power line options.

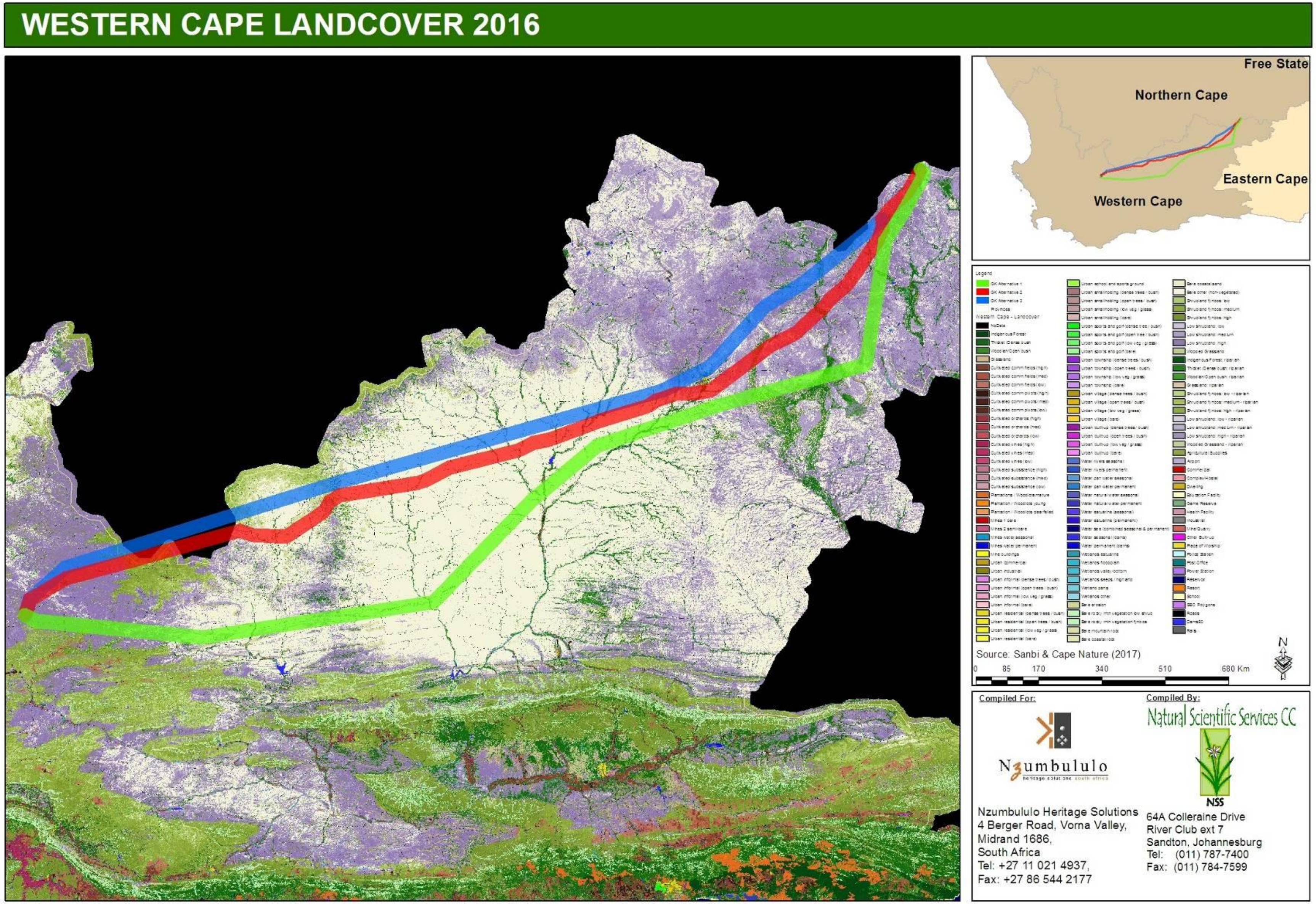


Figure 2-3 Western Cape Landcover Product (2014).

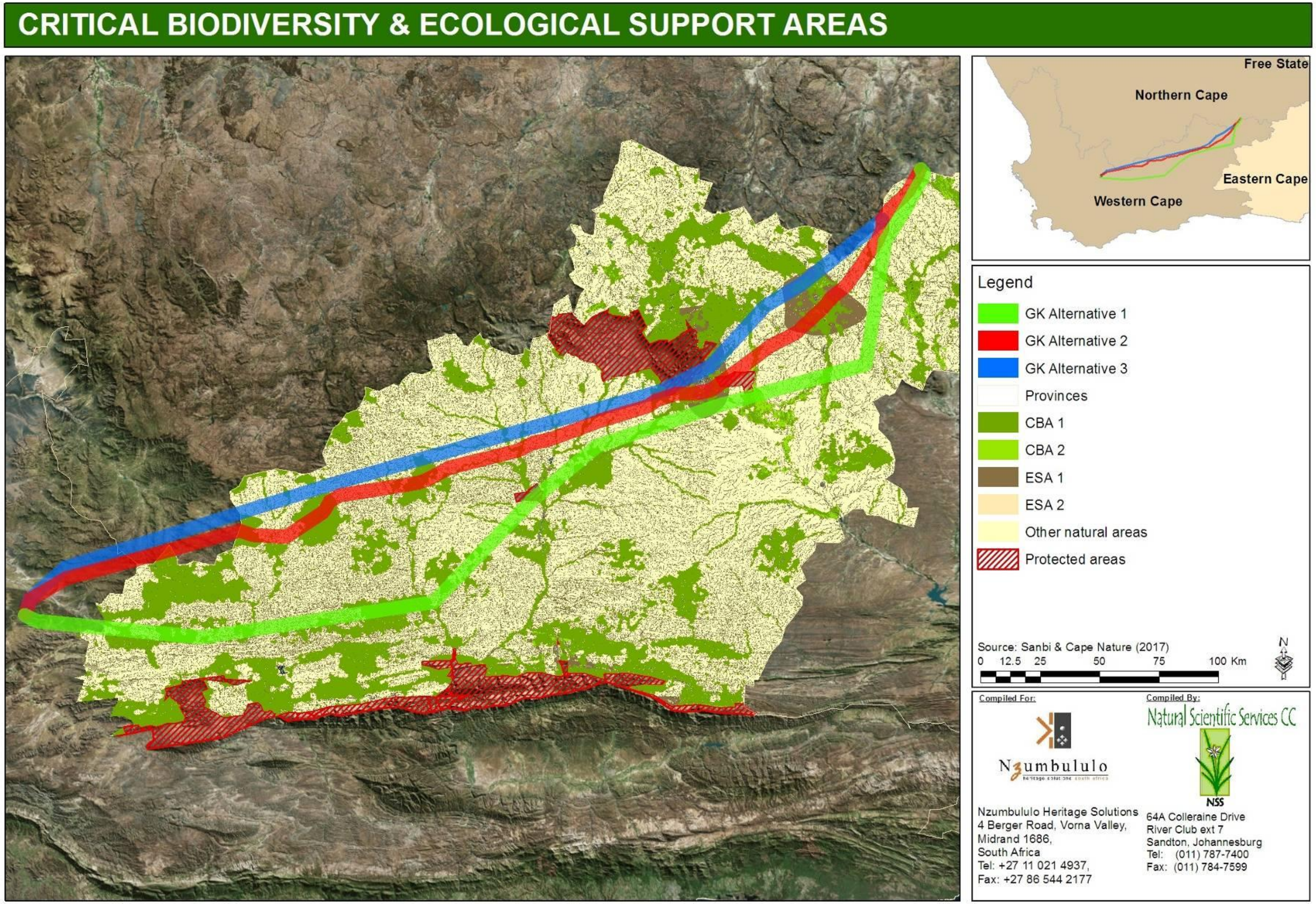
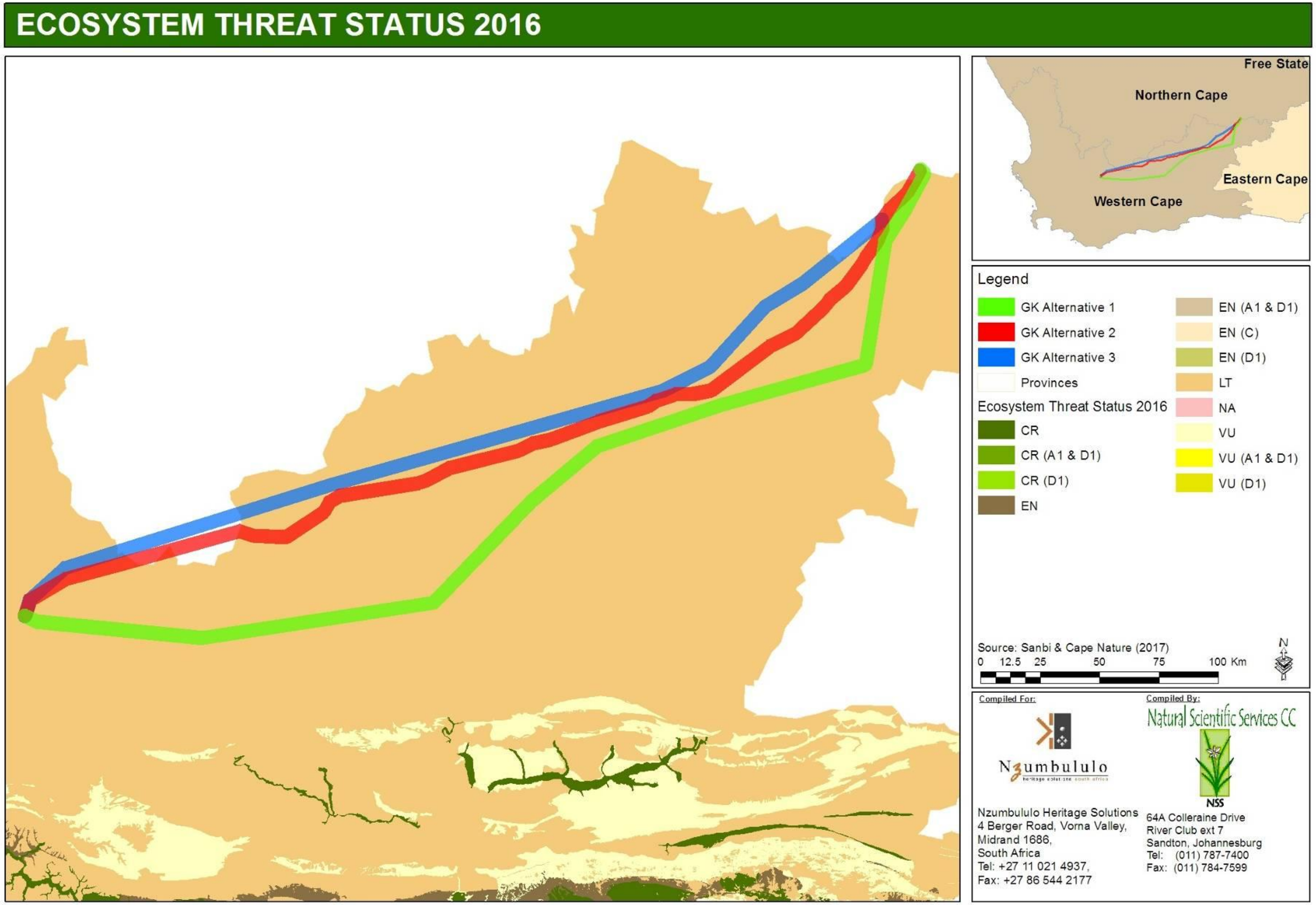


Figure 2-4 Western Cape Biodiversity Sector Plan (2017) Beaufort West, Laingsburg and Prince Albert municipalities.



2-5 Updated Western Cape Ecosystem Threat Status.

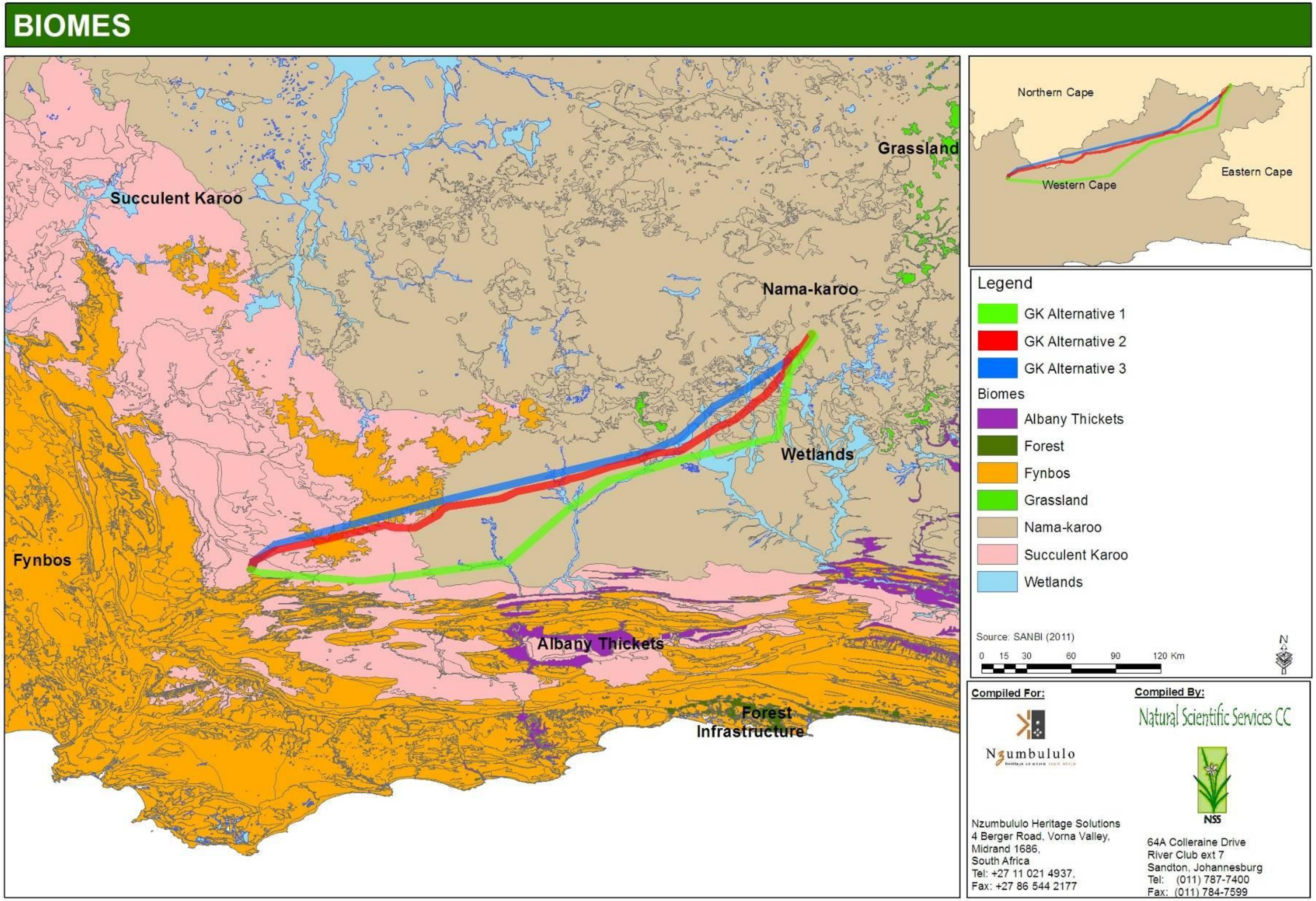


Figure 2-6 Biomes within the study area.

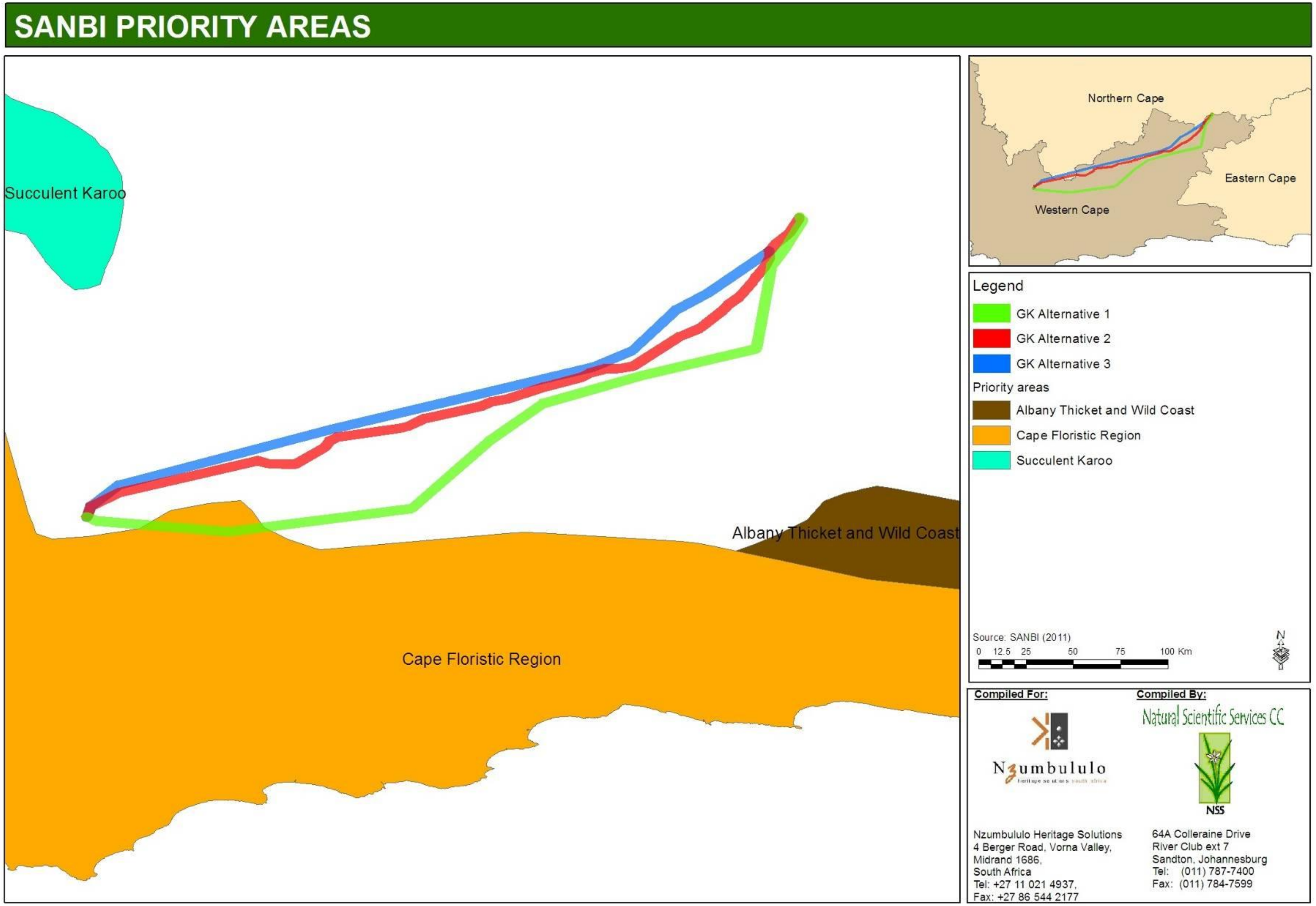


Figure 2-7 SANBI priority areas within the study area.

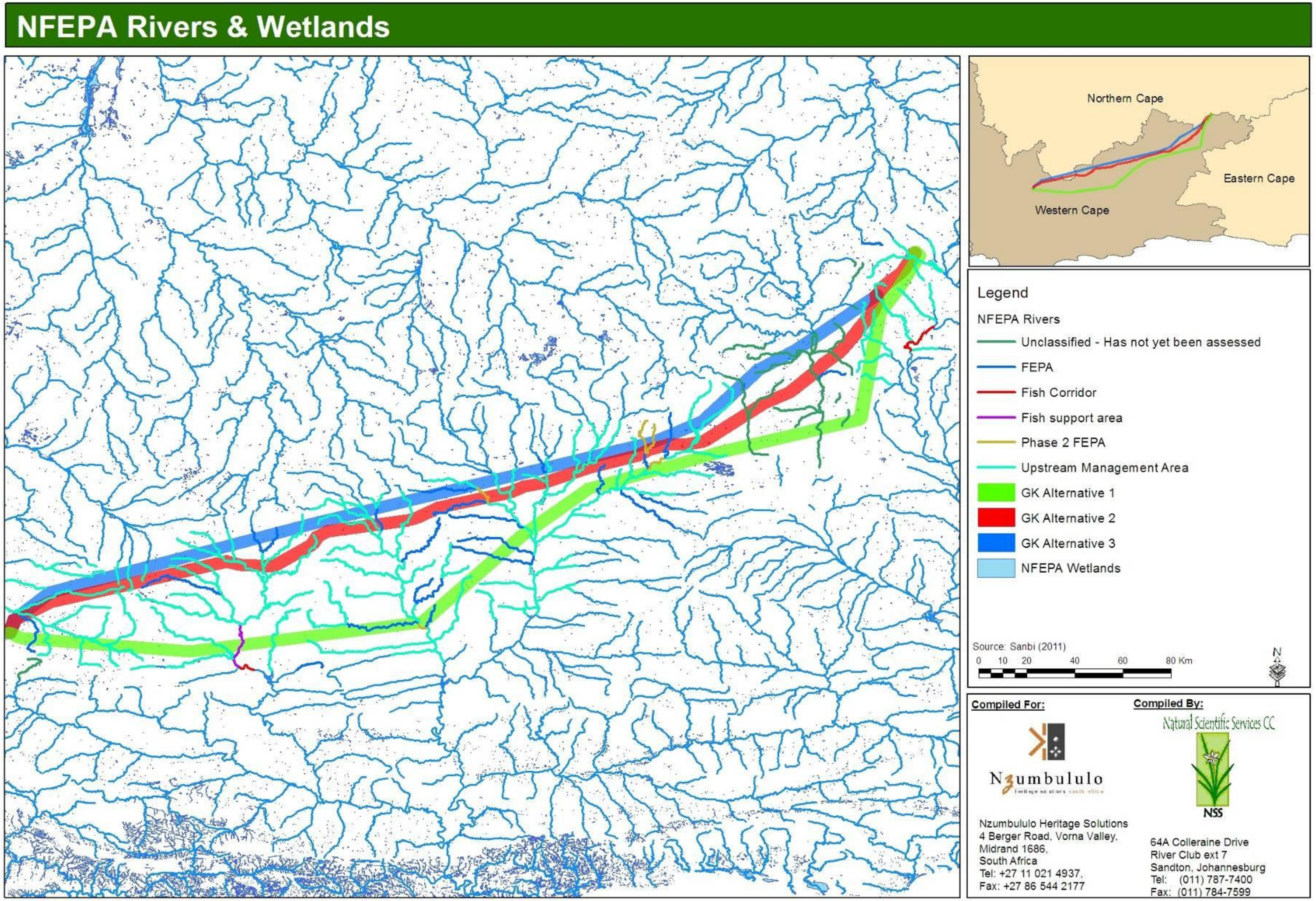


Figure 2-8 NFEPA rivers and wetlands within the area.

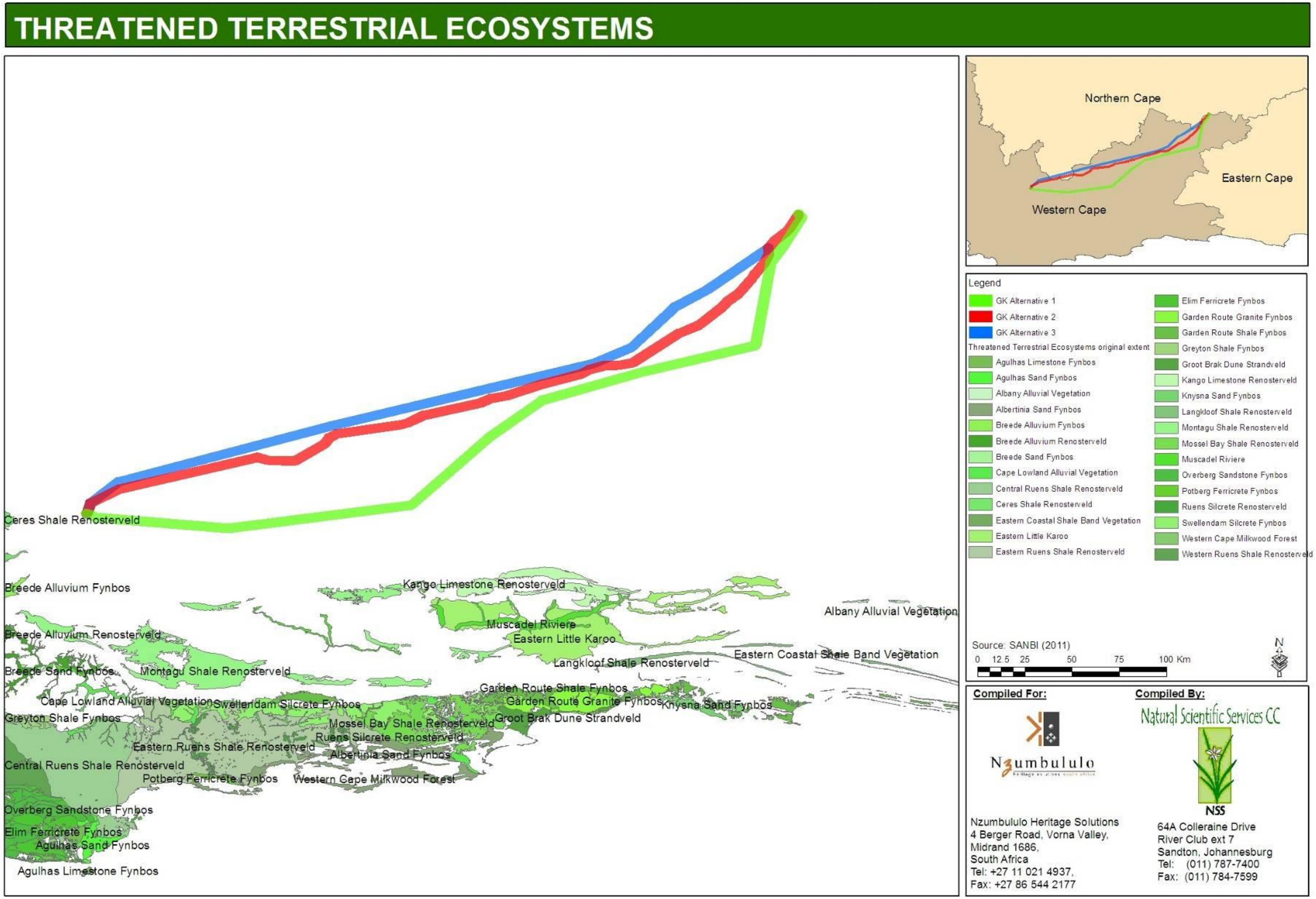


Figure 2-9 Threatened terrestrial ecosystems within the study area.

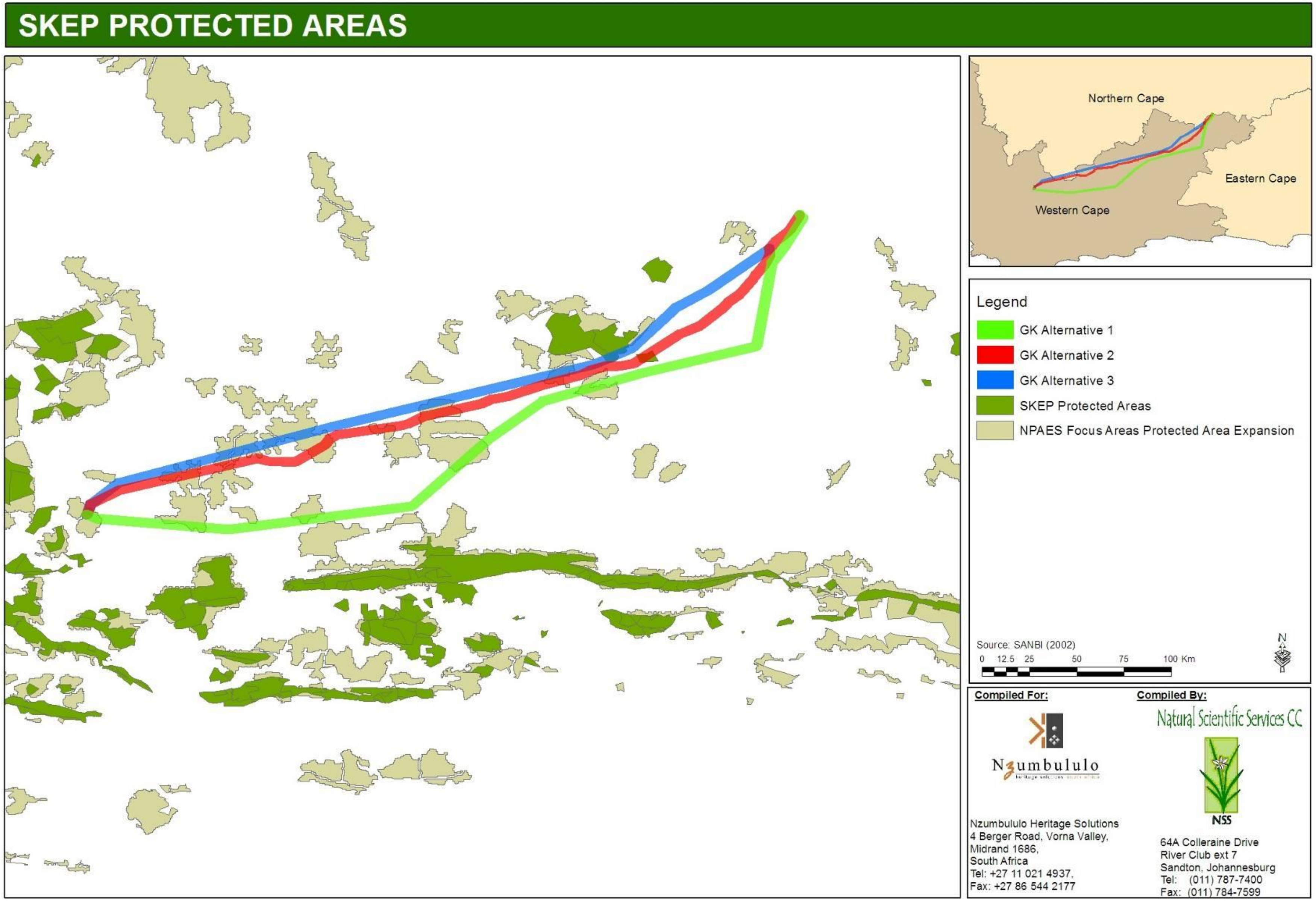


Figure 2-10 SKEP protected areas within the study area.

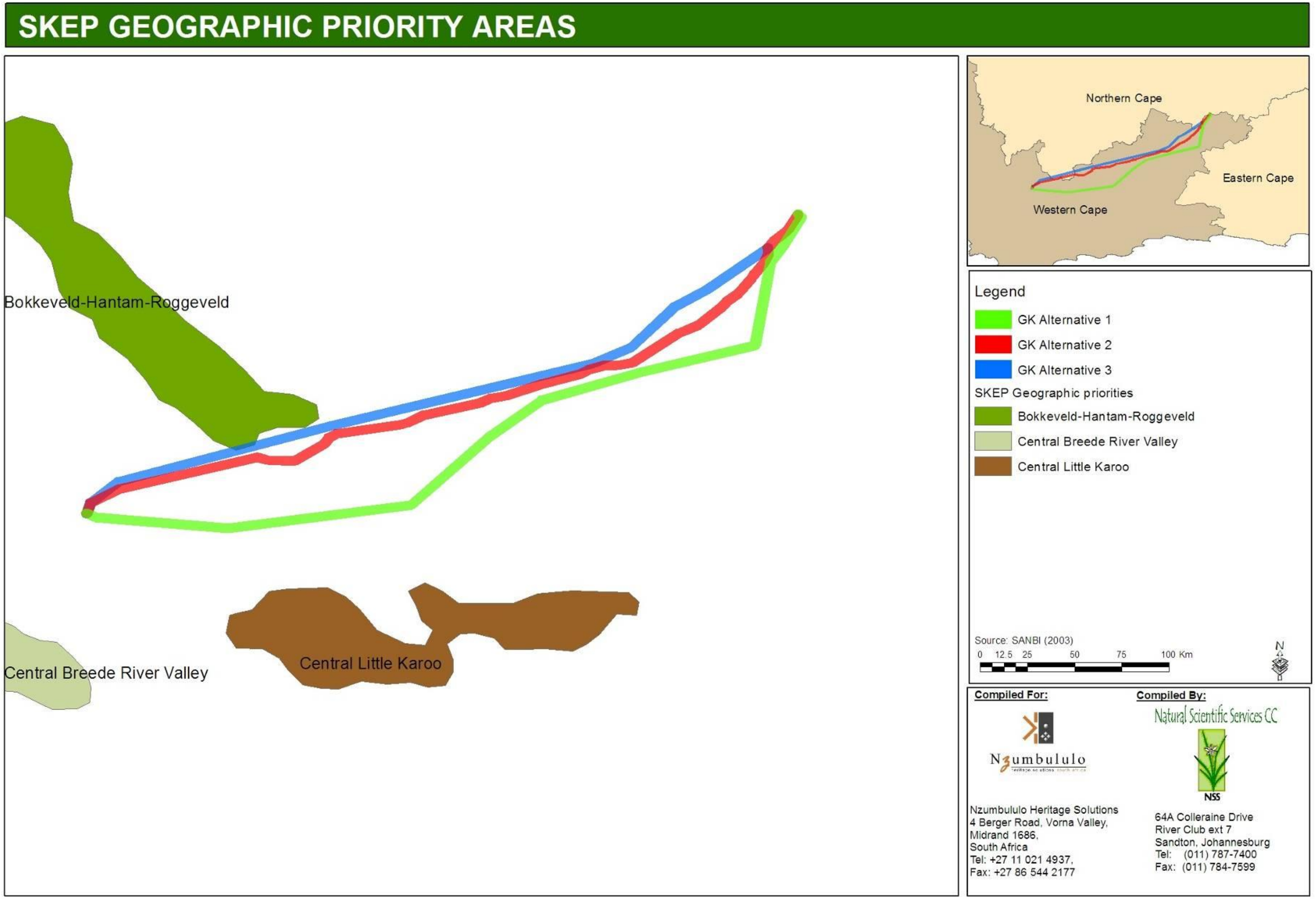


Figure 2-11 SKEP geographic priority areas within the study area.

3. Project Team

This desktop bat assessment was conducted and managed by NSS. The NSS team have extensive experience in project management and fieldwork for numerous ecological and biodiversity studies as well as aquatic and wetland assessments. The team have also been involved in the management of Environmental Impact Assessments (EIAs), Environmental Management Programme Reports (EMPRs), Strategic Management Plans (SMPs) and Environmental Management Plans (EMPs) for the Conservation, Mining, Waste, Commercial and Industrial sectors. The details of the project team are included in **Table 3-1**. In terms of accreditation and professional registrations the following is applicable to NSS:

- The senior team members are registered Professional Natural Scientists in the ecological, environmental and zoological fields.
- The aquatics team are accredited with DWA to perform the SASS macro-invertebrate monitoring method in South Africa.
- The Wetland Specialists are accredited through DWA to perform Wetland Delineations.

Table 3-1 Project team with associated areas of specialisation

Team Member	Project Role	Qualifications	Relevant Experience
Susan Abell	Review	▪ MSc Resource Conservation biology ▪ *PrSciNat* Registered (400116/05) -Ecology and Environmental Science	▪ Vegetation Assessments ▪ Conservation Important Species Scans ▪ Sensitivity Mapping ▪ Wetland Assessments ▪ Biodiversity Management & Action Plans ▪ State of Environment Reporting ▪ Environmental Management Frameworks ▪ Biodiversity Atlasing ▪ GIS Mapping & Database Design
Tyron Clark	Report writing, data analysis and modelling	▪ MSc Zoology in progress.	▪ Faunal Baseline Biodiversity and Impact Assessments. ▪ Wetland Delineation & Assessment ▪ Biodiversity Management & Action Plans. ▪ GBCSA Biodiversity Assessments. ▪ GIS Mapping & Database Design ▪ Ecological niche modelling.
Tim Blignaut	GIS	▪ BSc Honours - Geography	▪ GIS Mapping & Database Design ▪ Contaminated Land Assessments ▪ EIA's and EMP's

4. Methodology

4.1. Potential Species List

The list of potentially occurring bat species presented in **Table 5-1** was compiled using published species distribution maps in Friedmann & Daly (2004) and Monadjem *et al*. (2010). Species that were unlikely to occur in the study area were excluded from the list. The following scale, was used to assign a Likelihood of Occurrence (LO) for each species within the Gamma to Kappa study area:

1. High LO
2. Moderate LO
3. Low LO
4. Unlikely but Possible

4.2. Route prioritisation by climatic suitability

It was established in the preceding desktop study that, according to Australian research, fruit bats are particularly prone to colliding with and being electrocuted by electrical transmission lines (Bat Care Brisbane, 2013). In an initial attempt to assess which power line routes would pose the highest risk of fruit bat collision, basic climatic niche models were created for the two potentially occurring fruit bat species *Rousettus aegyptiacus* (Egyptian Rousette) and *Epomophorus wahlbergi* (Wahlberg's Epauletted Fruit Bat) which have subsequently been updated in this report.

The updated models differed in a few important ways from the initial models. Most importantly a target group background approach was employed. Very simply presence only species distribution models are built by supplying the modelling algorithm (in this case MaxEnt) with presence data (in the form of GPS locality points) and environmental layers which allows the model to compare environmental data associated with points where the species was recorded with points at which it wasn't. However in the updated models, instead of allowing MaxEnt to assign the default 10 000 pseudo-absences at random a target group was used. In this case all records of species within the Family Chiroptera (except the species being modelled) within the modelling area (Southern and Central Africa) was used (*R. aegyptiacus* n = 9425; *E. wahlbergii* n = 9311). Additionally the initial presence locality dataset was strengthened (*R. aegyptiacus* n = 76; *E. wahlbergii* n = 176) by including not only updated GBIF (2017) records but also a number of museum records as listed in Monadjem *et al*. (2010).

The overall approach was as follows. Presence data obtained from GBIF (2017) and Monadjem *et al*. (2010) together with target background (pseudo-absence) data obtained from GBIF (2017) was displayed in ArcMap (10.2) and vetted for accuracy and obvious geo-referencing errors. Thereafter the same eight global scale bioclimatic predictor variables as used in Schoeman *et al*. 2012 together with two other digital elevation related variables that we consider biologically relevant in predicting bat species distributions were sourced. The bioclimatic predictor variables were sourced from the WorldClim online database at a resolution of 30-arc second (Hijmans *et* *al*. 2005) and included annual mean temperature (bio 1), isothermality (bio3), temperature seasonality (bio4), minimum temperature of coldest month (bio6), Annual Precipitation (bio12), Precipitation of Wettest Month (bio13), Precipitation of driest month (bio14) and precipitation seasonality (bio15). The two DEM derived variables namely slope and aspect where sourced from the USGS GMTED database at 7.5 arc second resolution and where re-sampled to match the bioclimatic variables. The clipped environmental variables together with the presence and pseudo-absence data where then input into MaxEnt. Models for each species were run over five replicates with bootstrapping and evaluated using area under the curve (AUC) statistics. Model performance for both *R. Aegyptiacus* and *E. wahlbergi* was deemed excellent according to the ranking system provided by Swets (1988) with training AUC values of 0.966 (SD = 0.007) and 0.8491 (SD = 0.0427) respectively. Model outputs were then reclassified in Arc Map into six categories of climatic suitability ranging from absent (assigned as all values below the minimum training presence logistic threshold) to very high. The habitat suitability maps were used as a proxy for the probability of finding the species in a given location within the greater study area. Each of the various power line alternatives were then assigned a 50 m buffer and the models for each species clipped according to these polygons in order to calculate the proportion of each of the 6 suitability classes within each power line route. This allowed for the determination of which power line bisects the least amount of climatically suitable habitat and hence is least likely to adversely impact local fruit bat populations.

4.3. Route prioritisation by roost availability

Major geological formations that are likely to provide suitable roost conditions for cave / crevice dwelling bat species were delineated visually on Google Earth. This roost habitat type was selected as both *R. aegyptiacus,* as well as all of the potentially occurring conservation important bat species are dependent on it. Each power line route alternative was assigned a buffer of 2.5 km according to the SABAAP guidelines for potential roosts of 50 - 500 medium to high risk conservation important bats. The buffered route alternatives were then clipped according to the various roost polygons in ARC Map. This allowed for the determination of which power line bisects the least amount of potentially suitable roost habitat and hence is least likely to adversely impact conservation important bat populations.

5. Results and Discussion

5.1. Potentially occurring species

A total of twelve bat species from six families have the potential to occur from Gamma to Kappa based on a combination of known and predicted distributions of bat species published in Friedman and Daly (2004) and Monadjem *et al*. (2010) as well as findings from other NSS bat studies in the region. These species are listed in **Table 5-1** together with their current global and national conservation status as specified by the IUCN (2012) and Friedmann & Daly (2004) respectively. Additionally the table includes the anticipated new status for each species as based on upcoming EWT and SANBI Red List of Mammals of South Africa, Lesotho and Swaziland (in press). The 12 species differ in their Likelihood of Occurrence (LO) depending on their habitat requirements and other factors such as roost limitations.

Six Conservation Important (CI) bat species may occur from Gamma to Kappa. These include the Near-Threatened Cape Horseshoe Bat (*Rhinolophus capensis*), Geoffroy's Horseshoe Bat (*Rhinolophus clivosus*), Lesser Long-fingered Bat (*Miniopterus fraterculus*), Natal Long-fingered Bat (*Miniopterus natalensis*) Lesueur's Hairy Bat (*Cistugo lesueuri*) and Temminck's Hairy Bat (*Myotis tricolor*). It is important to note, however that the new Red List of Mammals of South Africa, Lesotho and Swaziland which is currently does not list these species as Near-threatened but rather Least Concern. With the exception of Wahlberg's Epauletted Fruit Bat (*Epomophorus wahlbergii*), Egyptian Rousette (*Rousettus aegyptiacus*) and Mauritian Tomb Bat (*Taphozous mauritianus*) all the potentially occurring bat species are listed as Protected Wild Animals according to the Western Cape Nature Conservation Laws Amendment Act 2000.

Table 5-1 Potentially occurring species within the Kappa to Omega study area.

FAMILY[1] & SPECIES[2,3]	COMMON NAME[2,3]	CONSERVATION STATUS				LO
		GLOBAL IUCN[4]	S.A. RED DATA CURRENT[2]	S.A. RED DATA IN PRESS[6]	WC LEGAL[5]	
PTEROPODIDAE (Fruit bats)						
Epomophorus wahlbergi	Wahlberg's	LC (S)	LC	LC		4
Rousettus aegyptiacus	Egyptian Rousette	LC (S)	LC	LC		3
EMBALLONURIDAE (Tomb bats)						
Taphozous mauritianus	Mauritian Tomb Bat	LC (U)	LC	LC		4
NYCTERIDAE (Slit-faced bats)						
Nycteris thebaica	Egyptian Slit-faced Bat	LC (U)	LC	LC	**PWA**	2
RHINOLOPHIDAE (Horseshoe bats)						
Rhinolophus capensis	Cape Horseshoe Bat	LC (D)	**NT (End)**	LC	**PWA**	3
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC (U)	**NT**	LC	**PWA**	3
VESPERTILIONIDAE (House, pipistrelle, serotine & related bats)						
Cistugo lesueuri	Lesueur's Wing-gland Bat	LC (D)	**NT (End)**	LC	**PWA**	3
Eptesicus hottentotus	Long-tailed Serotine	LC (U)	LC	LC	**PWA**	2
Miniopterus fraterculus	Lesser Long-fingered Bat	LC (U)	**NT (N-End)**	LC	**PWA**	4
Miniopterus natalensis / shreibersii	Natal / Shreiber's Long-fingered Bat	LC (U)	**NT**	LC	**PWA**	3
Myotis tricolor	Temminck's Myotis	LC (U)	**NT**	LC	**PWA**	2
Neoromicia capensis	Cape Serotine	LC (S)	LC	LC	**PWA**	2
MOLOSSIDAE (Free-tailed & related bats)						
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC (U)	LC	LC	**PWA**	2
Key						
Status: D = Declining; End = Endemic; LC = Least Concern; N-End = Near Endemic; NT = Near Threatened; PWA = Protected Wild Animal; S = Stable; U = Unknown; VU = Vulnerable						
Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low						
Sources: [1]Stuart & Stuart (2007); [2]Friedmann & Daly (2004); [3]Monadjem *et al.* (2010); [4]IUCN (2017-1); [5]Western Cape Nature Conservation Laws Amendment Act 2000; [6]Red List of Mammals of South Africa, Lesotho and Swaziland (in press)						

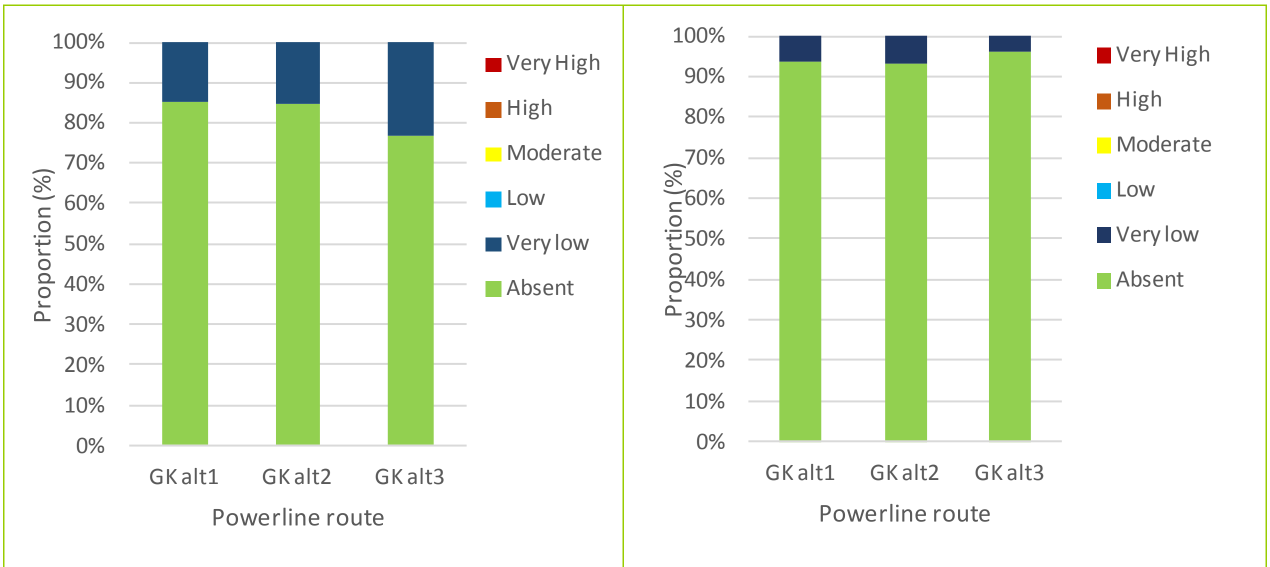
Of the various potentially occurring bat species fruit bats, in particular, appear to be most prone to collision with power lines (Bat Care Brisbane, 2013). The only two potentially occurring fruit bat species, namely Wahlberg's Epauletted Fruit Bat (*Epomophorus wahlbergi*) and Egyptian Rousette (*Rousettus aegyptiacus*) have a LO of unlikely and moderate respectively but are possible within the study area according to known and predicted distributions provided in Friedman and Daly (2004) and Monadjem *et al*. (2010). Of these two potentially occurring fruit bat species *R. aegyptiacus* is more likely to occur within the study area.

5.2. Habitat availability

The updated models for both species (**Figure 5-3** and **Figure 5-4**) broadly reflect the same overall result (i.e. that suitable climatic conditions are largely lacking within the study area) but differ in that the new models are more refined. The target background approach appears to have yielded a more biologically realistic picture of the species' distribution by minimising the effects of sampling bias thereby allowing the algorithm to be more generous in potentially suitable areas with few records while at the same time relaxing emphasis on areas with many records that be simply as a result of the ease of access (e.g. towns or roads). The inclusion of slope in the new models proved highly valuable in explaining the distribution of *R. aegyptiacus*. It appears that the species is highly associated with broken/hilly terrain which makes sense considering its dependence suitable cave roosting habitat. Both previous and current SDMs suggest that Lower precipitation levels and a less isothermal temperature regime (higher fluctuations in day-night and seasonal temperature variations) amongst other factors (such as fruit availability) likely preclude the presence of these species within the study area. Both previous and current models for both species do however predict a small patch of very low climatically suitable habitat around Beaufort West due to its warmer winter temperatures which are comparable with areas nearer the coast. Additionally the power line routes traverse geological formations which may provide suitable cave roosting habitat for *R. aegyptiacus*. As such the presence of fruit bats (although unlikely) along the length of the three power line route alternatives cannot be ruled out without comprehensive surveys along there length. A summary of the natural history and biogeography of the two species is given below:

Egyptian Rousette (*Rousettus aegyptiacus*): This large fruit bat (120 g) is widely distributed throughout sub-Saharan Africa and Arabia although it appears absent throughout large tracts of Central Africa. In South Africa the species appears restricted to more humid wetter areas of the country (possibly limited by the availability of fruiting trees) being distributed in a band from Cape Town in the south-west of its range westwards along the Indian Ocean coastal belt before broadening inland to Pafuri in the north. *Rousettus aegyptiacus* is a gregarious predominantly cave-roosting although the species which may occasionally make use of building ruins and trees as roost sites (Grzimek, 2003). As such, the species is further limited within its distribution by the availability of suitable roosting habitat (Monadjem *et al*. 2008). At suitable roost sites such as at Mission Rocks in St Lucia and caves in the vicinity of Tzaneen the species may gather in numbers of 5000 to 9000 individuals respectively. A strong and opposing seasonal fluctuation in the numbers of bats between these colonies has been observed and it is suggested (supported by the capture of individual at Cape Vidal, St Lucia that was tagged in Tzaneen) that the bats are likely migrating between these two colonies located some 500 km apart (Jacobsen and du Plesis, 1976). Accounts of *R. aegyptiacus* migration in the cape, however, appear to be lacking although the species is likely to undergo some form of seasonal movement between roosts.

Wahlberg's Epauletted Fruit Bat (*Epomophorus wahlbergi*): A large sandy brown bat yet smaller than R. *aegyptiacus* (ca. 100 g). Unlike the former, *E. wahlbergi* roosts singly or in small groups within the dense foliage of trees. This species does not echolocate. It is widely distributed throughout Sub-Saharan Africa. The species distribution models presented in this report suggests the species occupies a broader range of climatic conditions and hence occupies a broader distribution. The models also suggest a less strict dependence on slope while placing a greater emphasis on isothermality. It appears the species frequents mesic environments. This reflects the species independence on cave or other suitable subterranean roosting habitat which has allowed the species to occupy a far greater extent of lower lying tropical to subtropical areas. However the conditions along three Gamma to Kappa powerline routes do not appear to provide these conditions.



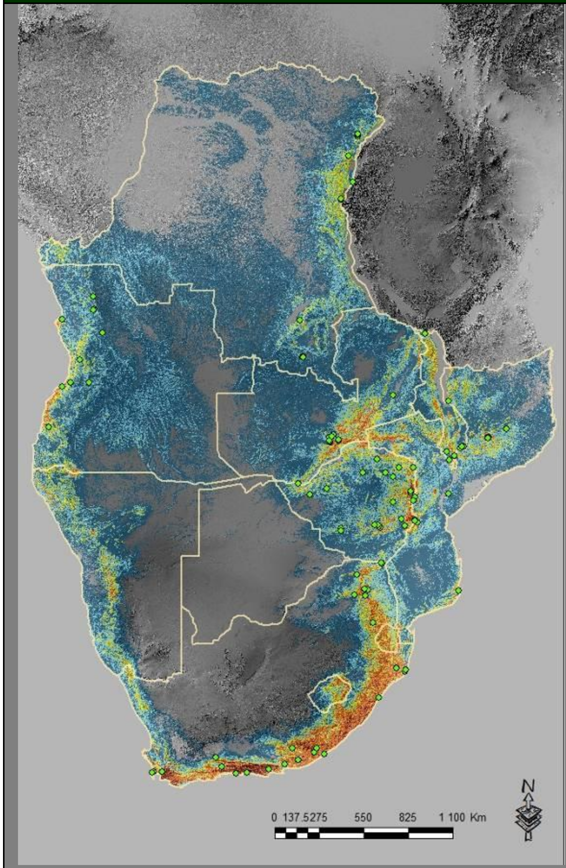
R. aegyptiacus	*E. wahlbergi*

Figure 5-1 Proportion of each power line route option occupied by each of the climatic suitability classes; absent, very low, low, medium and high.

Figure 5-3 and **Figure 5-4** show that the Gamma to Kappa powerline route alternatives are situated within a very marginal zone of climatic suitability for both species. For *R. aegyptiacus* most of the habitat covered is climatically unsuitable with only some small patches of Very Low suitability. However these areas are associated with broken / hilly terrain and thus may be an artefact of the models strong emphasis on slope as a predictor variable. For *E. wahlbergi* there is little difference in terms of the amount of climatically suitable habitat traversed by each power line route and the vast majority of habitat is unsuitable. Overall there is little difference between the routes (in terms of climatic suitability – all very low suitability), however, the southerly trajectory taken by GK alt 1 most closely approaches the coastal distribution of both species and is, therefore, less preferable than GK alt 2 from a climatic suitability perspective.

Table 5-2 Summary of climatic suitability and roost availability for both fruit bat species.

***Rousettus aegyptiacus* (Egyptian Rousette)**

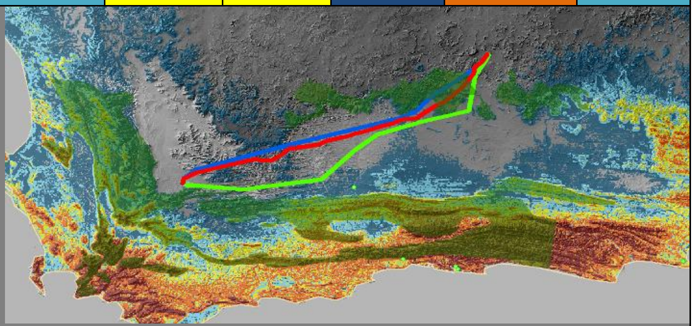


Description: A large (ca. 120g) mostly slatey-brown fruit bat. No epaulettes or white fur tufts at base of ears.

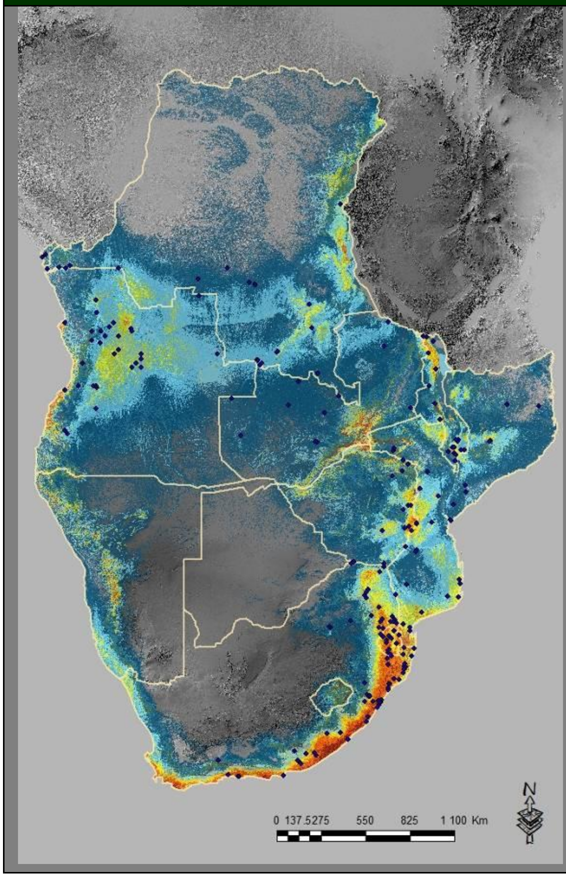
Notes: Widespread in Sub-Saharan Africa, Arabia and southern Palearctic. Roosts gregariously in caves. Does echolocate.

Anticipated Risk (Climate and Roost)

Alt 1		Alt 2		Alt 3	
Roost	Climate	Roost	Climate	Roost	Climate
L	M	M	VL	H	L



***Epomophorus wahlbergii* (Wahlberg's Epauletted Fruit Bat)**

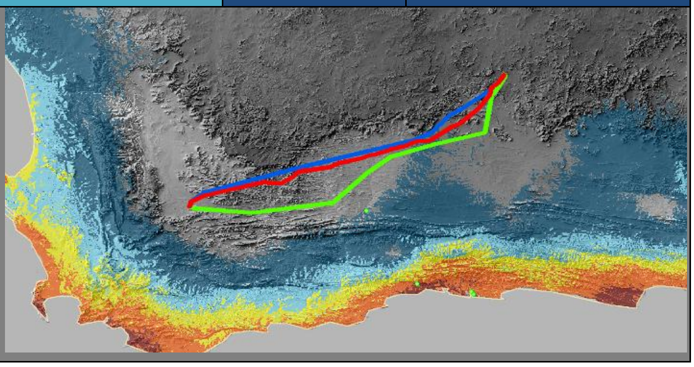


Description: A large sandy-brown fruit bat, smaller than *R.aegyptiacus* (ca. 100g). Epaulettes and white tufts at base of ear present.

Notes: Widespread in Sub-Saharan Africa. These models reflect its more ubiquitous distribution, likely afforded by its tree roosting habits.

Anticipated Risk (Climate)

GK Alt 1	GK Alt 2	GK Alt 3
L	VL	VL



In terms potential roost availability for *R. aegyptiacus* and other cave / crevice roosting bat species, **Figure 5-2** shows that the power line route alternative (and its associated 2.5 km linear buffer) that traverses the least amount potentially suitable roost habitat is GK alt 1 (7196.57 ha) followed by GK alt 2 (32490.67 ha) and GK alt 3 (36623.41 ha).

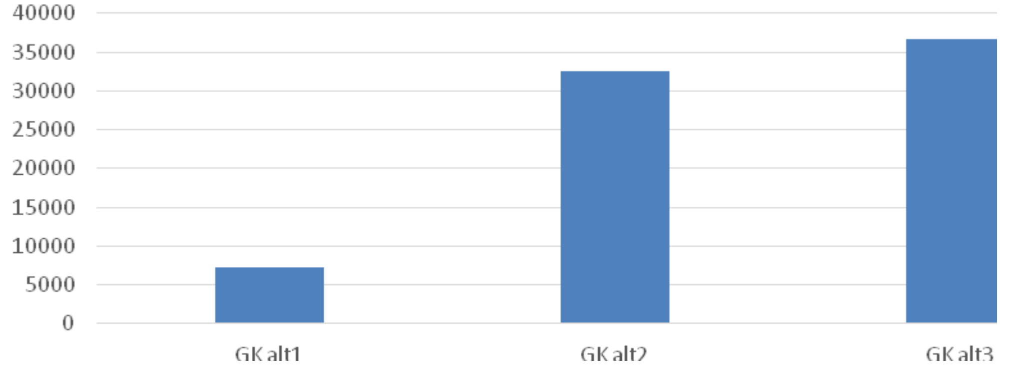


Figure 5-2 Area of potentially suitable cave/crevice roost habitat traversed by each power line route.

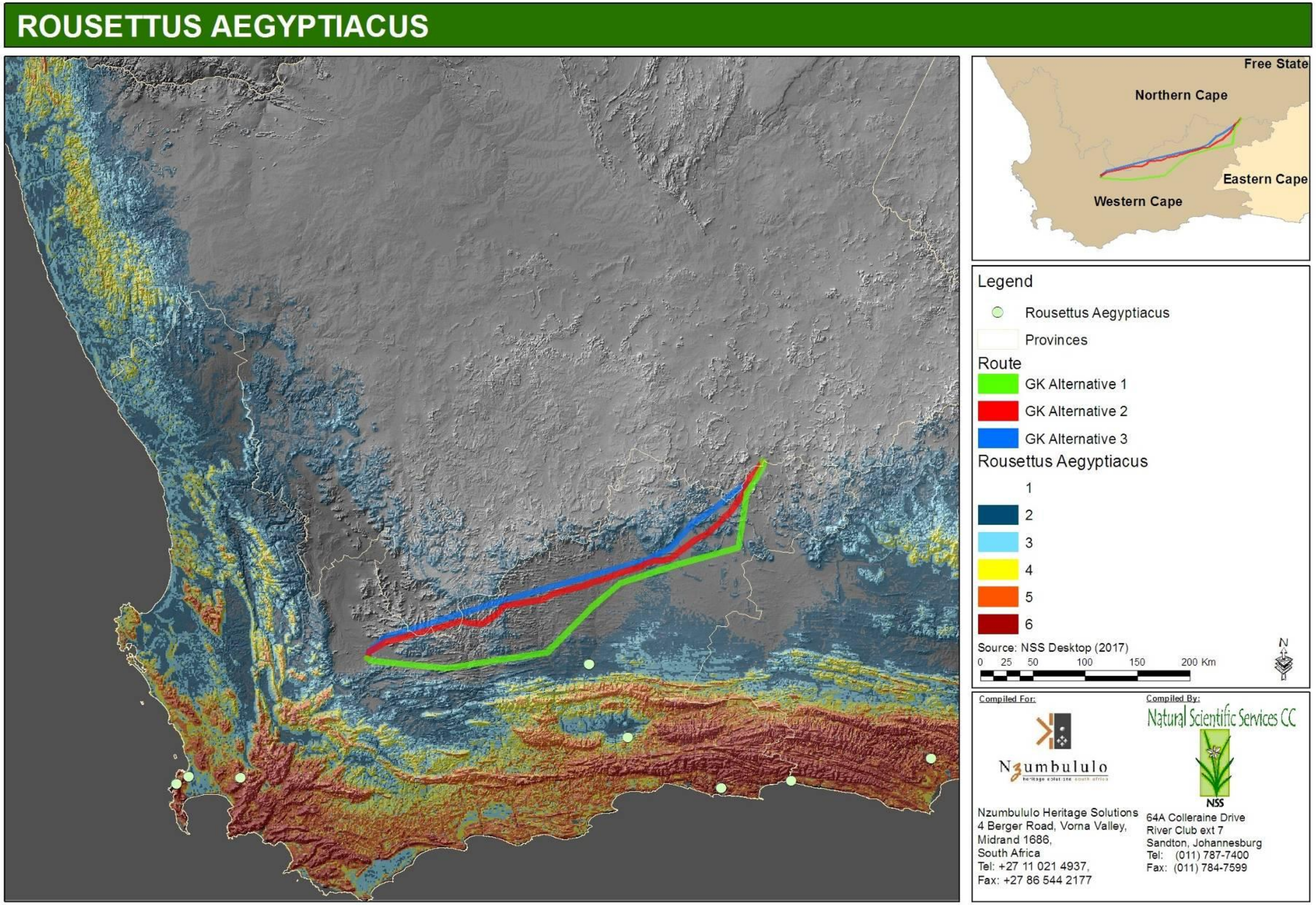


Figure 5-3 Climatic suitability model output for *Rousettus aegyptiacus*.

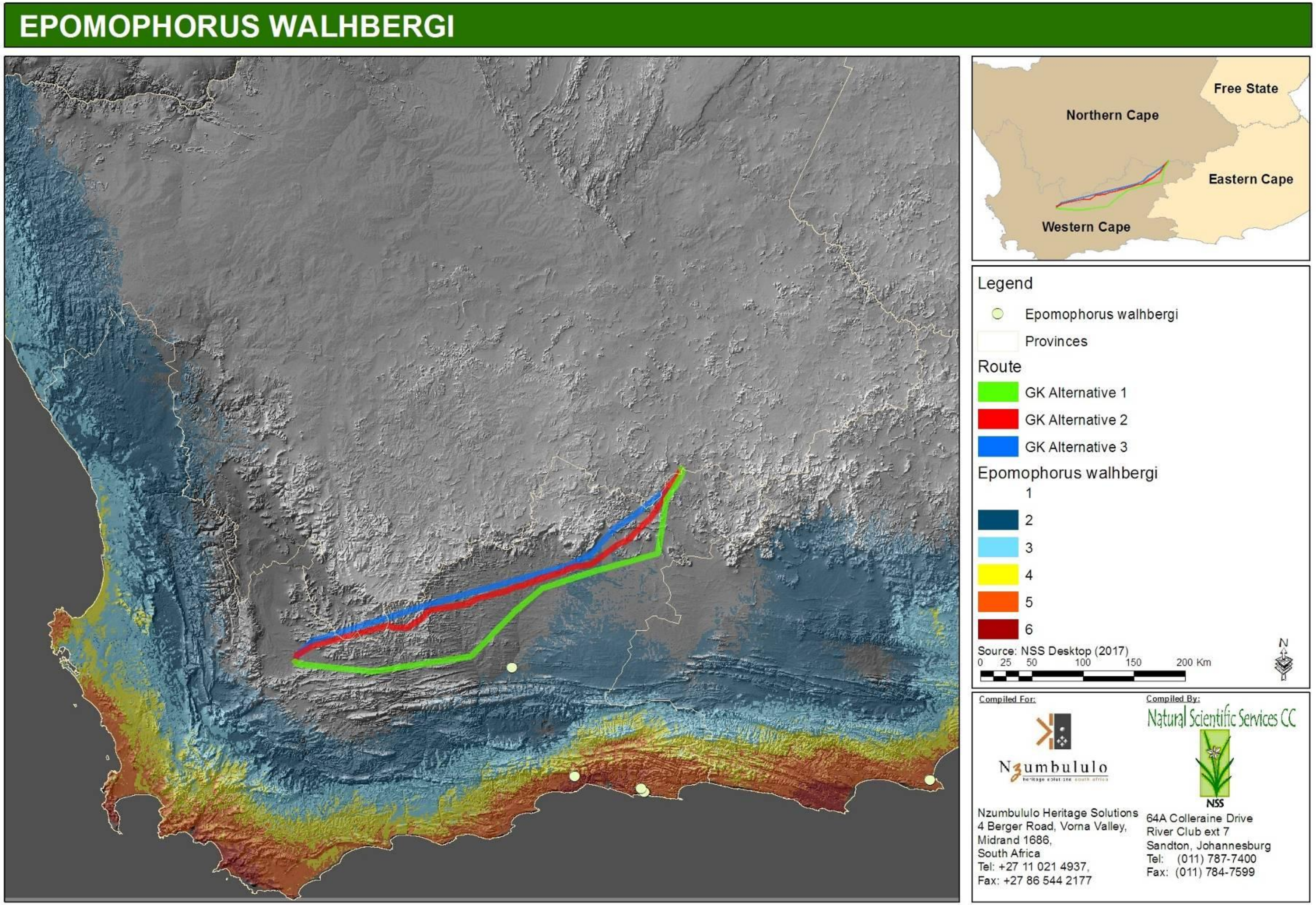


Figure 5-4 **Climatic suitability model output for *Epomophorus wahlbergi*.**

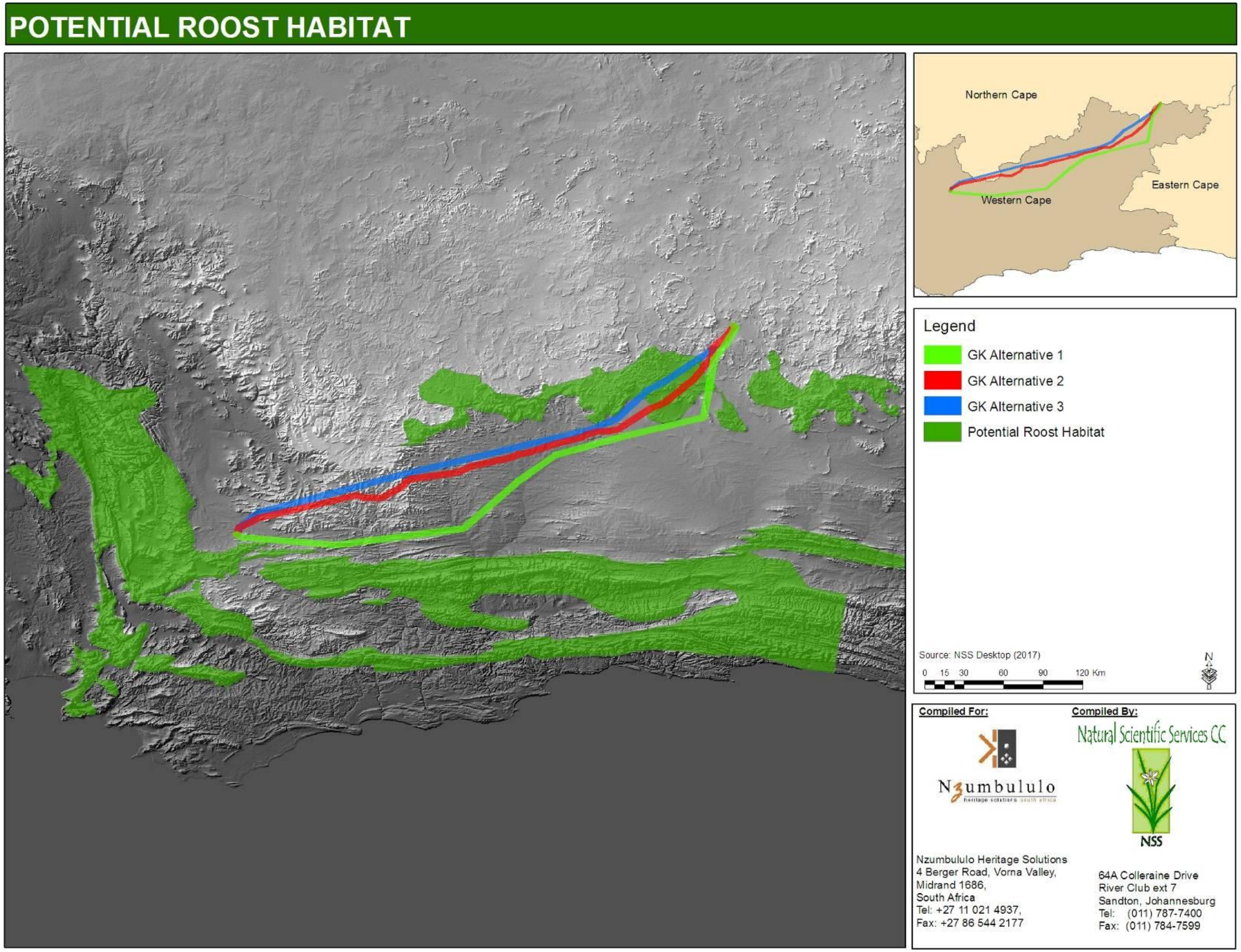


Figure 5-5 Potentially suitable cave roost habitats traversed by each of the power line routes.

6. Potential impacts

6.1. Construction phase

Impacts to bats during the construction phase are mainly indirect. Although the construction phase is short-term, the impacts may affect bats over the long-term.

6.1.1 Habitat loss / degradation

Removal of vegetation or blasting of rock within the power line right of way will result in a loss or alteration of potential roosting and foraging habitat. This impact is expected to continue into the operational phase, as vegetation within the right of way is usually cleared on a regular basis.

Ameliorating the effects of this impact would involve selecting the route with the least amount of bat suitable habitat and minimising the clearing of vegetation (particularly trees) within the right-of-way, as far as practically possible.

6.1.2 Sensory disturbance:

Increased levels of noise, dust and vibrations generated during construction may lead to increased sensory disturbance and the temporary avoidance of the area by bats. Dust from vehicles movements may affect the foraging success of resident bats. Most terrestrial faunal groups are particularly sensitive to disturbance with the majority, tending to inhabit areas away from the noise and movements created by people, and moving machinery. Bats, in particular gleaning bats (those that pick their prey directly from substrates) are especially sensitive to the effects of noise and increased human activity. Gleaning bats use soft (low amplitude), high frequency echolocation calls to locate and then pick their prey from objects. Egyptian Slit-Faced Bat (*Nycteris thebaica*) is a gleaning bat that is likely to be negatively impacted by noise and vibrations associated with construction of the power line. Further to this construction should continue into the night and be timed so as to avoid the breeding seasons of local bats (parturition for most of the potentially occurring species takes place in summer from October to February).

Mitigation of these impacts may include the implementation of dust control measures such as sprayer trucks (where practical) to avoid dust accumulating on vegetation used by bats or their prey as food or as roosting sites. Noise mufflers should be used on heavy commercial vehicles and idling should be minimised wherever possible.

6.2. Operational phase

During operation, transmission lines may affect bats both directly through collision and electrocution, as well as indirectly through electromagnetic radiation and habitat fragmentation.

6.2.1 Collision

Power lines are known to represent a significant collision threat to some species of bats (Taylor and Anderson, 1973; Crawford and Barker, 1981; Don *et al*. 1988; Mumford and Whitaker, 1982; Fenton, 2001). This effect was exemplified in a study by Krystufek (2009) on Indian flying foxes (*Pterupus gigantenus*) in Sri Lankan Paradeniya Botanic Garden. The study revealed that dead bats were regularly found hanging on the power lines and that on one particular day as many as 74 carcasses were found over a 3 km stretch of power line. There seems to be a paucity in scientific research as to exactly why bats collide with man-made structures (Osborne et al., 1996 and Johnson et al. 2000). Collision related impacts may be compounded if the power line is erected along established migratory pathways. Whether or not any of the three power line alternatives intercept major migratory bat pathways is uncertain and can only be tentatively assessed following detailed bat monitoring along these routes.

The power line route that traverses the least amount of potential bat roosting habitat (**Figure 5-2**) and that avoids any corridors of mass migration identified during detailed field surveys should be opted for.

6.2.2 Electrocution

Bat electrocution usually occurs when their wings simultaneously come onto contact with a live wire and neutral wire, a live wire and earthed object or two energized wires. Incidents of bats being electrocuted by powerlines mostly appear to involve fruit bats. In Australia, Grey-headed foxes are frequent victims of powerline electrocution due to their large wingspans and their tendency to roost upon them after foraging (Bat Care Brisbane, 2013). To minimize this risk of electrocution, the power lines and other live / neutral structures should be spaced at the very least at distances wider than the wingspan of the largest potentially occurring bat species *R. aegyptiacus* which may reach 60 cm (Kwiecinski and Griffiths, 1999). Where this is not possible, the cables should be insulated.

6.2.3 Electromagnetic radiation

According to Black and Black (2008), electromagnetic radiation can cause serious harm to animals. The effect of electromagnetic field radiation depends on the dose. Different doses may have different effects. Acute doses especially at high voltages may be instantly fatal whereas prolonged exposure to low doses may have cumulative effects causing behavioral and physiological defects (Galeeve, 2000; Lai, 2005; Adey, 1997). Unfortunately, studies on the effects of electromagnetic radiation on wildlife are exceedingly rare. Among the studies which have been done, bird populations appear most well-studied. Physiological effects in birds range from plumage deterioration to movement problems, as well as albinism and melanism (Balmori, 2003). Other effects include decreases in sperm motility and the bird’s response to photoperiod due to altered melatonin levels Fernie (1999). Electric fields have also been known to disrupt the chemical gradient and signals to embryo cells thereby resulting in malformation. Berman *et al*. (1990) adds that malformation in the nervous system, the heart and delayed embryo growth have also been observed.

Electromagnetic radiation is also said to have behavioural effects on bats and rats. Nicholls and Racey (2007) state that the activity of bats is significantly reduced in areas where they are exposed to electromagnetic field strengths exceeding 2 volts / meter. Nicholls and Racey (2009) went further to say that pulsed electromagnetic radiation from a small, affordable and portable radar system can reduce bat activity within a given area.

Changes in muscle and nervous system functioning are observed in living tissues when electric current density reaches over 10mA/m2. Considering that the effects of electromagnetic radiation is inversely proportional to body size and age, smaller mammals such as bats are particularly prone to the negative effects of prolonged exposure to time varying low-frequency radiation (ICNIRP 1998).

Mitigating the effects of electromagnetic radiation is limited but will be best achieved by avoiding the areas where bats may congregate for prolonged periods such at roost sites or around water holes.

6.2.4 Habitat Fragmentation

If echolocating bats do indeed avoid the electromagnetic fields around power lines, the repellent effect may be significant enough to deter bats from crossing these lines. Studies on European bats have shown that light pollution from highways deter bats to the extent that some species do not cross the highways and consequently suffer from habitat fragmentation. If electromagnetic fields have a similar repellent effect, there exists the possibility that the power lines may contribute towards the fragmentation of habitat of local bat species particularly low flying species.

7. Conclusions and Recommendations

Some 12 bat species have the potential to occur within the Gamma to Kappa powerline study area. Six of which are currently listed as Near-threatened status, however a pending publication by EWT and SANBI is likely to see the reduction of the status of all these species to Least Concern (Red List of Mammals of South Africa, Lesotho and Swaziland, in press). Although Australian research suggests fruit bats are particularly prone to collision with and electrocution by power lines, the likelihood of fruit bats occurring within the study area is low. Only two species have a very slight possibility of occurring, namely *R. aegyptiacus* and *E. wahlbergii*. To investigate this further species distribution models were initially created in the first report and then subsequently re-run using more sophisticated approaches in this report. The newer models appear to have provided a more accurate and biologically relevant representation of the distribution of these species but the overarching result is the same. Both past and current models for both species suggest that the hot, dry and highly variable temperature regime of the Karoo, likely precludes the presence of these species throughout the study area, except perhaps in a small patch near Beaufort West where winter temperatures remain warm enough.

The potential impacts to bats during the construction phase include habitat loss associated with clearing the right of way (which is expected to continue into the operational phase) and sensory disturbance due to increased levels of noise and dust associated with heavy vehicles and other machinery. During the operational phase, bats (particularly fruit bats) could potentially be negatively impacted by collision with power lines and to a lesser extent electrocution by them. Other impacts associated with the operational phase include electromagnetic radiation emitted by the power lines and its potential repellent effects, which may in turn lead to habitat fragmentation of certain species. The impacts suggested may be compounded if the power line is erected along bat migratory routes.

NSS and IFC Worldbank recommended prevention and control measures to minimize bat impacts due to power lines include:

- Dust control measures during construction should be employed.
- Noise mufflers should be used on heavy commercial vehicles and idling should be minimised wherever possible.
- Maintaining 1.5 meter spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;
- Aligning transmission corridors to avoid critical habitats (e.g. nesting grounds, heronries, rookeries, bat foraging corridors, and migration corridors);
- Should any bat fatalities be observed, these should be reported to the Eskom EO. If there is good reason to believe the death was as a result of the powerline then the EO should contact the South African Bat Assessment Advisory Panel (SABAAP). This contact information should be made available to surrounding landowners and I&APs, so they are able to report any fatalities.

Mitigating any potential effects of electromagnetic radiation but will be best achieved by avoiding the areas where bats may congregate for prolonged periods such at roost sites or around water holes.

The initial report highlighted that the final power line route should take a route that traverses the least amount of (1) Climatically suitable fruit bat habitat, (2) potential roosting habitat for all bat species (particular cave/ crevice dwelling species) and (3) Nationally protected / threatened rivers, wetlands or ecosystems. This updated report supports the findings of the initial report in that the power line route alternative GK alt 2 appears to be the most preferable, as it parallels existing power line infrastructure along its entire length. GK alt 1 is the second most preferable route, as it follows the N1 for a considerable distance and traverses the least amount of possible cave roosting habitat for *R. aegyptiacus*. GK alt 3 appears to be the least preferable route, as it does not parallel existing power lines and it also traverses the most amount of potential cave/crevice roost habitat.

It was recommended in the initial report that if GK alt 3 was to be opted for that a dedicated groundtruthing fieldwork be commissioned. Encouragingly, however, since the initial report communications Nzumbululo Heritage Solutions (NHS), suggest that Eskom are only considering GK alt 2 for construction. The other alternatives presented in this report were included for comparative purposes (should this change). In conclusion although the potential for bat collisions can never be ruled out, it is NSS' opinion, that the proposed powerline development (GK alt2) should not pose a significant threat to the bat fauna, which according to the literature, are most likely to collide with or be electrocuted by them.

8. References

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